Identifying the Reasons Why They Won't Leave: Fire Alarm Activations at the Housing Authority of Grays Harbor Manors

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Abstract

The purpose of a fire alarm system is to provide early warning so evacuation movement can occur during the incipient stage of a fire. The problem addressed by this research was the Aberdeen Fire Department (AFD) had not identified why some occupants at four Housing Authority of Grays Harbor (HAGH) residential manors were not evacuating during fire alarm activations. The purpose of this research was to identify the causal factors of poor evacuation movement and explore viable alternatives to total building evacuation. Descriptive research utilizing semistructured interviews of the HAGH occupants and data retrieved from the National Fire Incident Reporting System (NFIRS) database were used to answer the research questions: (a) What is causing fire alarm activations at the HAGH manors? (5 year data survey), (b) What are the physical or personal barriers preventing some occupants from evacuating?, (c) What is the current compliance with evacuation procedures?, (d) For the occupants who do not evacuate, what is their rationale for not evacuating?; (e) What training or education have the occupants received on evacuation procedures?, (f) Are there alternatives to total building evacuation that achieve occupant safety? A survey instrument was developed and semistructured face-to-face interviews of 189 occupants residing at the manors were conducted. The results indicated the causal factors of poor evacuation movement were false alarms and alarm activations from burned food, occupants looking for secondary confirmation in the form of smoke or fire, waiting to see what actions other occupants were taking, and waiting for further instructions. Recommendations to improve evacuation movement included strategies to reduce false alarms and alarms due to burned food, the development of evacuation plans specific to each manor, the utilization of shelter-in-place and phased evacuation strategies, and the provision of training to the occupants that promoted positive evacuation behavior.

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Introduction

The purpose of a fire alarm system is to provide early warning to the occupants that a fire is occurring in their building. Many building evacuation plans are based on the premise that once alerted by the sound of a fire alarm, the occupants will immediately start evacuating their building. Although simple in concept, existing research, case studies, and anecdotal evidence involving human behavior in response to fire alarms indicates that fire alarms are often not meeting this objective.

The problem addressed by this research is the Aberdeen Fire Department (AFD) has not identified why a significant number of occupants residing in the Housing Authority of Grays Harbor (HAGH) residential manors are not evacuating their buildings when there is an activation of the automatic fire alarm system.

The purpose of this research is to identify causal factors contributing to the occupants' poor compliance with building evacuation during fire alarm activations and explore viable alternatives to building evacuation specific to each manor and occupant demographic.

Descriptive research utilizing semistructured interviews of the HAGH residential occupants and data retrieved from the National Fire Incident Reporting System (NFIRS) database were used to answer the following research questions: (a) What is causing the fire alarm activations at the HAGH manors? (5 year data survey), (b) What are the physical or personal barriers preventing some occupants from evacuating?, (c) What is the current compliance with evacuation procedures during fire alarm activations?, (d) For the occupants who do not evacuate, what is their rationale for not evacuating?; (e) What training or education have the occupants received on evacuation procedures?, (f) Are there alternatives to total building evacuation that achieve occupant safety?

Background and Significance

The Executive Analysis of Community Risk Reduction (EACRR) course at the National Fire Academy stressed that the Executive Fire Officer should "help lead the process of identifying and prioritizing community risk" (Federal Emergency Management Agency [FEMA], 2009, p. 1-17). As part of the pre-course community risk analysis, this author identified that the residents living at the HAGH complexes comprised a high risk population. People considered to be at high risk for injury or death from fire include the elderly, the mobility impaired, cognitively impaired, sensory impaired, and the impoverished (Federal Emergency Management Agency [FEMA], 1999). To gain further insight into the risks facing the occupants of the HAGH manors, this author contacted the Chief Operations Officer of the HAGH to ascertain what he felt presented the most significant risk to the occupants. Without hesitation he stated he was concerned about the occupants not evacuating their buildings during fire alarm activations (J. Raines, personal communication, November, 2010). Based on personal experience from responding to emergency incidents at the manors and from research conducted while at the National Fire Academy, it was determined that the occupants' behavior in response to fire alarm activations warranted further research. The importance of considering human behavior is addressed by Au (2009) who suggested that:

> People and their activities are probably the most important element in emergency responses. Because of the nature of the circumstances that people find themselves in, human errors and (undesirable) human behavior can be a major issue and they must be taken into consideration in emergency planning. (p. 443)

The environment in which people reside also contributes to their behavior during an emergency. O'Connor (2005) indicated that a building's characteristics play a significant role in

occupant response during a fire alarm. The characteristics that promote occupant evacuation include a functioning alarm system, easily accessible exits, and places of refuge. O'Connor added that these parameters should be predetermined for each building and included in education and training programs for a building's occupants.

The HAGH manages multi-residential complexes within Grays Harbor County in Washington State. The HAGH, operating under the auspices of the U.S. Department of Housing and Urban Development, provides affordable housing to low-income persons. To qualify for occupancy, the resident must meet income level requirements set by the U.S. Department of Housing and Urban Development and the HAGH. The HAGH is compliant with the Americans with Disability Act of 1990 and does not discriminate against persons regardless of disability, religion, race, creed, or national origin. This is significant because residents are placed in apartments as they become available. The result is tenants who are mobility impaired and unable to use emergency stairwells can be found residing in upper floor apartments in all four manors.

This research project will focus on the HAGH manors located within the AFD's response area. The AFD is the primary fire protection agency for the three HAGH manors located within the City of Aberdeen and responds to a fourth manor in the adjacent City of Hoquiam as part of an automatic response agreement. Operationally, the AFD operates one engine, one truck, one ambulance, and a command vehicle with an eight person minimum staff. The Hoquiam Fire Department (HFD) operates two engines and one ambulance with a five person minimum staff. In the event of a fire, the HAGH manors pose a significant response challenge to the AFD and HFD due to the limited number of firefighters responding in proportion to the large number of occupants residing in each manor. In fact, Dunn (2003) claimed that a fire department's strategy for fighting fires and protecting occupants in multi-residential buildings is determined by the

number of firefighters responding to the emergency and the construction type of the building. Dunn stated that large metropolitan fire departments can assign engine companies to suppress the fire while truck companies perform occupant evacuation. In contrast, Dunn claimed that smaller fire departments with a limited initial fire response should employ a strategy to suppress the fire while simultaneously removing residents who are directly impacted by the smoke and heat. For the occupants not directly impacted, Dunn recommended that a shelter-in-place strategy be utilized.

The HAGH manors included in this research range from three to nine stories in height and contain from 30 to 130 apartments. All four manors have non-pressurized emergency stairwells that are marked by illuminated exit signs and have elevators servicing the upper floors with signs indicating that occupants should not use the elevators in the event of a fire. All elevators are equipped with Phase I and Phase II operational capability. The manors are not protected by a sprinkler system in either the apartments or common areas. Each apartment has an emergency evacuation plan posted on the interior surface of each apartment door which indicates the location of emergency exits and manual fire alarm pull stations. The emergency evacuation plan for all four manors directs the occupants to evacuate the building via the stairs in the event of a fire or fire alarm activation. The fire alarm system for each manor consists of a Fire-Lite Alarms Inc. MS-9200 addressable control panel that receives input from smoke alarms located in the common interior hallways, elevator lobbies, laundry facilities, and other common areas of the buildings. Heat detectors are located in the elevator control rooms, maintenance areas, and utility spaces. Manual fire alarm pull stations are located on each floor adjacent to the emergency stairwells. Fire alarm horns with flashing strobes are located approximately every 50 feet along each hallway and in each common area but are not located in each apartment. Each

apartment unit contains at least one battery operated smoke detector that is not linked to the general fire alarm system. The door to each apartment is made of solid wood construction that does not have self-closing hardware. The specific characteristics for each manor are as follows.

Aberdeen Manor

The Aberdeen Manor (AM) was built in 1970 and is a Type II noncombustible building constructed of concrete and masonry. Each of its 130 apartments located on five floors have access to an exterior balcony. The apartments consist of studio or one bedroom units each with its own kitchen. The building has nine floors overall with occupants living on floors five through nine. Floors one through four contain laundry, maintenance, meeting, and office spaces. Primary occupant egress to the exterior is located on the fifth floor which is the ground floor Side C of the building. It is shaped in an “L” configuration with emergency stairwells located at the end of each interior common hallway and one in the center of the building. The two stairwells at the end of each hallway are equipped with fire department standpipe connections. The elevator shaft for this building contains two cars and is located in the center of the building adjacent to the center stairwell.

Broadway Manor

The Broadway Manor (BM) was built in 1972 and is a Type II noncombustible building constructed of concrete and masonry. The building has 69 apartments located on five floors, each with its own kitchen. The building is configured in an “L” shape and has emergency stairwells that are standpipe equipped at the end of each interior common hallway and an elevator shaft operating two cars located in the center of the building. Only sixteen upper floor apartments have access to exterior balconies and they are the corner apartments located on the Alpha and Bravo sides of the building.

Hoquiam Manor

The Hoquiam Manor (HM) was built in 1967 and is a Type II noncombustible building constructed of concrete and masonry. It contains 40 apartments located on four floors, each with its own kitchen. The building is rectangular in shape with standpipe equipped emergency stairwells at the end of each interior common hallway. The building is equipped with two elevators that operate in separate shafts located at one end of the building.

Skyview Manor

The Skyview Manor (SM) was built in 1981 and is a Type V wood-frame building constructed of wood framing with sheetrock wall covering. The roof system is lightweight wood truss. The building contains 30 apartments located on three floors, each with its own kitchen. The building is rectangular shaped with standpipe equipped emergency stairwells located at the end of each interior common hallway. A single car elevator shaft is located in the center of the building. This building has fire resistant metal doors that automatically close when the fire alarm system activates. When closed, the doors separate the interior common hallways into two separate zones and isolate the elevator lobbies from the common hallways.

The significance of this research is the introduction of risk reduction analysis modeling to the AFD. Formal risk reduction analysis has not been a process utilized by the AFD to address the hazards faced by those we serve. It is hoped this research will provide insight into the current behaviors inherent to the occupants of the HAGH manors so that positive and negative behaviors can be identified and included in future operational strategies. Specifically, this research will examine the HAGH occupants' response to fire alarm activations in order to improve their safety and enhance the AFD's ability to safely mitigate fire incidents. It is expected that in addition to the problems associated with fire alarm activations, other issues will

arise during the course of this research that impact the wellbeing of the occupants. The AFD plans to use the results of this research, as well as all ancillary information gained from the occupant surveys and NFIRS data, to develop a targeted public education program that will then be presented to the occupants of the HAGH.

The linkage between the problem addressed by this research and the EACRR course is the application of the Community Risk-Reduction Model presented in Unit I. Specifically, Step II of the model, Assessing Community Risk, requires that the problem be analyzed, the hazards and causal factors identified, and vulnerabilities assessed. It is hoped this research will accomplish these activities in order to develop recommendations for interventional strategies associated with Step III of the model (FEMA, 2009). This research project also addresses the United States Fire Administration's (USFA) Strategic Goal #1: Reducing Risk at the Local Level through Prevention and Mitigation. This research directly supports the goals' initiatives to expand public fire safety education to high risk groups and to develop cooperative alliances with agencies having direct contact with high risk audiences. This research also supports Goal #2: Improve Local Planning and Preparedness, by expanding the AFD's use of NFIRS data and informational analysis in planning and preparedness programs (United States Fire Administration, 2010).

Literature Review

Past research on human behavior in response to fires and fire alarms will be reviewed for comparison to the findings of this research. Also, the pros and cons of various evacuation strategies will be explored to determine their efficacy for use at the HAGH manors.

One extreme of human behavior in response to fire is panic as depicted on television and in the movies, however, experts in the field of human behavior and fire engineering question if

panic is truly a behavior exhibited by people faced with a dire situation. Chertkoff and Kushigian (1999) researched seven incidents in the United States that involved emergency situations and the resulting egress of large crowds. The authors used investigative reports compiled at the time of each incident to gain insight into the psychological response and corresponding physical actions of the people and crowds who faced the emergencies. Chertkoff and Kushigian indicated that "social scientists, in the main, have defined 'panic' as a two-component concept, with the components being high emotional arousal and irrational behavior" (p. 117). They added, however, that what defines irrational behavior is subject to interpretation and is difficult at best to determine after the fact. Chertkoff and Kushigian claimed that society often ascribes the term panic to those individuals or groups whose course of action at the time of the incident results in a negative outcome; however, if the actions taken by the individual or group result in a positive outcome the actions are termed heroic. To further define crowd movement, Chertkoff and Kushigian divided evacuation movement into three phases. Each phase has unique factors that, when present, created a heightened emotional state that led to poor outcomes for people attempting to exit. During the first, or precondition phase, a heightened state of emotional arousal occurred when there was a lack of exits, narrow passageways, a large number of people present, poor knowledge of the location of exterior exits, and lack of an emergency plan or training on emergency procedures. In the second, or reactions to the event phase, a heightened emotional state occurred when the individual or group became aware that if they did not evacuate in a timely manner the consequences would be dire was coupled with their awareness that the time available to exit was short. During the third, or reactions to the event once people start moving phase, the authors found that once a large crowd started moving, individual action was almost physically impossible. The authors also noted that people often

used the most familiar path to an exit, even when it was not the most beneficial path, often resulting in injury or death. Chertkoff and Kushigian asserted the way people are made aware of an emergency is critical to their subsequent response. They stated people become aware of a problem by many means but normally it is verbally or through some form of alarm. If the initial warning is vague in communicating that the outcome severity is high and the time to respond is low, as is the case with the sound of a fire alarm, people will move slowly, if at all. If, however, the initial warning communicates clearly that the outcome severity is high and the time available to exit is low, people's emotional arousal will be high but they will move in an orderly fashion at an appropriate speed. Proulx (1997) in discussing panic behavior wrote:

> The notion that people caught in a fire will panic and stampede has long been rejected by psychologists. Panic has rarely been observed as a human response to danger from fire. In fact, most people appear to apply rational decision-making relative to their understanding of the event at the time of the fire. (p. 36)

Research by O'Connor (2005) concluded "deaths in large-scale fires attributed to 'panic' are far more likely to have been caused by delays in people receiving information about a fire" (p. 3). Further research into panic behavior was conducted by Fahy, Proulx, and Aiman (2009) who reviewed fire incidents to determine if panic behavior was present. They proposed that the term panic is often assigned inappropriately by the media to those whose actions appear irrational. Their findings concluded that panic, in the terms of irrational behavior, is rarely seen in fires and "descriptions of panic relate more to fear or heightened anxiety than any sort of behavior leading to the death or injury of a person" (p. 395).

Throughout the literature review for this research paper it was apparent the study of human behavior in relation to fire was critical to achieving safe outcomes. The attitudes,

behaviors, and actions of a building's occupants in response to fire and fire alarms are dependent on many factors. Proulx (1997) listed the occupant's age, gender, mobility, alertness, and training as key factors. Proulx also reported the stage of fire development and location of the fire played a key role in occupant behavior. Occupants who hear the fire alarm and detect the smell of smoke will react differently compared to occupants in other parts of the building who only hear the fire alarm. Proulx noted however, that some occupants, even upon hearing a fire alarm and smelling smoke, will choose to ignore the alarm, deny there is a problem, and not begin evacuation movement.

Of concern to those in the fire engineering field is in the past many building designers did not account for human behavior when designing egress systems. O'Connor (2005) agreed with Proulx (1997) that older evacuation models were flawed because they assumed people would evacuate their building immediately upon hearing a fire alarm. Both authors reported that many evacuation models were based on the mathematical equivalent of water flowing through a pipe. Proulx (1997) found that in reality the opposite is true. True human behavior involves seeking more information, moving towards the fire, using the most familiar exit routes, and moving at varying speeds. O'Connor (2005) claimed older evacuation models may correctly reflect occupant behavior in occupancies with practiced leadership-oriented plans such as schools and refineries but are not appropriate for residential apartment buildings.

Proulx (2007) stated that by design, fire alarm systems have several objectives. The alarm alerts the occupants that there is a fire, prompts them to take immediate action, initiates evacuation movement, and provides early warning so the occupants are evacuating during the incipient stage of the fire. Proulx claimed fire alarms are generally not meeting the designed objectives. According to Proulx, studies indicated for most occupants to begin the evacuation

process, additional confirmatory cues, other than the sound of a fire alarm, must be received. The cues normally involved the smell of smoke, the presence of fire, directions from those in authority, or the sound of approaching sirens. Proulx also reported that during the time occupants should be taking immediate action to evacuate, many negative behaviors have been observed. The negative behaviors included investigating the cause of the alarm, seeking out friends or family, retrieving belongings, or ignoring the alarm altogether. On a positive note, Proulx stated both the tendency of occupants to wait for confirmatory evidence and their negative evacuation behaviors can be overcome by education and training. Au (2009) agreed with Proulx (2007) that people required confirmatory information in addition to the sound of a fire alarm. Au reported additional information is crucial to the decision making process but, that unfortunately in the early stages of an incident, information is often vague and ambiguous. Au contended that some occupants make errors in judgment during emergency incidents because the events are rare and they do not appreciate the level of risk they are facing.

Research by the Society of Fire Protection Engineers-Task Group on Human Behavior [SFPE] (2003) found that people who are alone will respond more rapidly to ambiguous clues such as fire alarms than if they were in a group. They found other factors effecting a person's propensity to respond immediately to the sound of a fire alarm were their familiarity with the building, whether they were asleep, impaired by drugs or alcohol, or whether they had any physical, medical, or cognitive disabilities. Females were also found to respond more appropriately to fire alarms than males by warning others of the danger and then beginning to evacuate, whereas males were more likely to search out and attempt to extinguish the fire. The SFPE also reported age was a significant determinant of occupant response to fire alarms. Specifically, it was found that as humans age there is a decrease in sensory skills, decision

making skills, and mobility which directly impacted a person's ability to react swiftly and appropriately to fire alarm activations and fire incidents.

Most researchers agree there are a series of cognitive steps people must make in order to respond appropriately to fire alarm activations. Kobes, Oberije, Groenewegen, Helsloot, and De Vries (2009) divided the evacuation process into three basic activities. First, there is the validation period when the person becomes aware of danger through some external stimulus such as hearing a fire alarm or smelling smoke. Second, the danger is validated and the decision to seek refuge or evacuate is made. Third, the action to stay or evacuate is carried out. Kobe et al. (2009) defined the first two processes as the pre-movement phase and the third process as the movement phase. The authors stressed proper occupant response during the pre-movement phase is the most critical in determining occupant survival. O'Connor (2005), in referring to the pre-movement phase, listed three human processes that must take place. The occupant must "receive the cue (sense the cue), recognize the cue (identify the cue), and interpret the cue (give meaning to the cue)" (p. 4). O'Connor added the factors determining how each person worked through the process included their age, gender, culture, physical and cognitive abilities, familiarity with the building, whether they were alone or in a group, and their prior experience with fire or building evacuations. O'Connor stressed ambiguous information, such as the sound of a fire alarm, without additional confirmatory cues will most often result in the occupant going in search of validating information, waiting for additional information, or ignoring the alarm completely.

Exposure to previous fire incidents also has a significant impact on a person's subsequent response to fire and fire alarms. Au (2009) claimed that because the majority of people have never been in a fire situation they are not sure what actions they should take. Au stated analysis

of past fire events indicated when a fire occurs, a significant portion of the population will be reacting to a real event for the first time and many make incorrect decisions. Au also claimed by nature, people tend to adhere to their daily routines, but the sudden disruption caused by the sound of a fire alarm forces them to abandon their activity and respond appropriately. Au suggested the propensity of people to want to maintain normalcy in their daily routine may result in the largest delay during the pre-movement phase following the activation of a fire alarm. Meacham (2009) in referring to the human experience with fire found most occupants consider the likelihood of a fire to be low and the risk negligible due in large part to how fire is portrayed on television and in the movies. Meacham found the general public dangerously underestimated how lethal and fast developing fires can be.

Proulx (2007) identified four reasons occupants fail to respond appropriately to fire alarms. First, they fail to recognize the sound of the fire alarm. Evidence suggested some occupants mistake the sound of a fire alarm for that of a burglar alarm, elevator fault, or other warning sound. Second, the occupants did not know what actions they should take when the fire alarm system activated. Third, when the occupants of a building are subjected to nuisance alarms such as false alarms, fire drills, and alarm system tests, they tend to ignore the sound of a fire alarm. During an evacuation study of a mid-rise residential complex, Proulx found that only 25% of the occupants considered the sound of the fire alarm to represent a true emergency. According to Proulx, as few as three nuisance alarms in a one year period are sufficient to cause occupants to ignore the sound of a fire alarm. The fourth factor contributing to the lack of response to fire alarms was some occupants were unable to hear the alarm when they were inside their apartments. This is particularly true of buildings, such as the HAGH manors, that have fire alarm horns mounted in the common hallways of the building and not in each apartment. The

sound of appliances such as televisions, radios, and air conditioning units are often enough to mask the sound of the alarm. Proulx reported fire alarm horns mounted in hallways have also been found to be ineffective in awakening some occupants from sleep. This was especially true for the elderly, those under the influence of drugs or alcohol, and the hearing impaired. Further complicating the impact of nighttime fire alarms was the observation by Bruck and Tokley (2009) who proposed the poor compliance displayed by some occupants during nighttime fire alarm activations could be attributed to what they described as sleep inertia. They used the term sleep inertia to describe the reduced cognitive ability of people abruptly wakened from sleep. Their study indicated most people are in their deepest sleep cycle during the three to four hour period after midnight. They found the effects of sleep inertia can last for 20 to 30 minutes after awakening and was exacerbated in persons taking medications such as Zolpidem or benzodiazepines. Increasing the decibel level of a fire alarm system to facilitate awakening people at night is not a viable solution according to Proulx (2007). Proulx claimed fire alarms that are too loud promote tampering by the occupants and more importantly, prevent effective communication in the hallways of the building. According to Proulx, communication among occupants congregating in a hallway is a critical first step in deciding on a proper course of action. Proulx stressed an alarm that is too loud would also hamper effective communication between firefighters and occupants, a situation that causes many fire departments to silence the fire alarm immediately upon arrival. Proulx insisted this is a dangerous practice as case studies indicated once the alarm was silenced some occupants ceased their evacuation movement and returned to their apartments even though a true fire event was occurring.

Of particular interest to this researcher was the work by Miller (2009) who described factors that increased the vulnerability of adults 65 years or older to the incidence of fire. The

factors included mobility issues, risky behaviors, age-related decline, medication usage, contact with heat sources, and economic factors. To remain within the context of this research paper, the impact of mobility and age-related decline will be discussed further as they directly impact a person's ability to respond appropriately to fires and fire alarms. According to Miller, mobility issues restrict a person's ability to move away from fire if it is near, and away from smoke if they are exposed. Stairs can be seen as impassible and the inability to crawl on their hands and knees prevents them from crawling under a layer of smoke to a place of refuge. Miller also noted that with age comes a lack of agility and balance which may prevent the elderly from using alternative exits such as windows. Age-related decline encompasses a reduction in physical strength, sensory ability, and cognitive ability. Miller concluded that as people age, there is a decrease in their overall sensory acuity which negatively impacts their ability to react swiftly and appropriately to a fire incident.

In addition to the mobility issues cited by Miller (2009), Ahrens, Hall, Comoletti, Gamache, and LeBeau (2007) reported the elderly are at significant risk from burn injuries while cooking, and that cooking fires are one of the leading causes of residential fires and fire related injuries in the United States. The impact of cooking fires on HAGH evacuation movement will be addressed further in this research paper.

It is understood that a functioning well designed fire alarm system is a critical life safety feature of a building. Also evident in the literature review was the importance of a building's evacuation plan. According to the SFPE (2003) the occupant demographics of a building must be identified in order to evaluate if the plan will accommodate those with special needs. The SFPE stressed the occupants must be aware of the plan, have received training on the plan, and that both occupants and emergency responders must be aware of the procedures they are

expected to follow. In the National Fire Protection Association's (NFPA) *Emergency Evacuation Planning Guide for People with Disabilities*, five disability categories were identified that must be taken into consideration when developing an evacuation plan. The categories included disabilities effecting mobility, vision, hearing, speech and cognition (NFPA, 2007). According to the NFPA, a building's evacuation plan must consider the constraints a disability places on an individual's ability to safely evacuate. For mobility impaired occupants, the use of ramps, areas of safe refuge, stairwell use, elevators, and evacuation buddies should be considered. For the visually impaired, audible fire alarms, Braille signage indicating escape routes, and the assignment of a person to lead them to safety were proffered solutions. For the hearing impaired, strobe lights that activate in conjunction with the audible fire alarm are required by building and fire codes. Finally, to aid in the development of an evacuation plan for those with cognitive impairments, their degree of disability must be evaluated as "all standard egress systems require a person to be able to process and understand information in order to safely evacuate a building" (NFPA, 2007, p. 11). Suggested solutions for this group included color coded exit doors and escape paths, picture books depicting what to do in an emergency, implementing a buddy system, and routine training and coaching. An important message contained within this report was "disability is not about a specific group of people. Disability is about a specific time in the life of each and every one of us" (NFPA, 2007, p. 43). According to the NFPA, 70% of all Americans, at one time in their lives, will experience a disability that prevents them from using stairs to evacuate a building. Therefore, the NFPA concluded that evacuation planning must take into consideration the person who is temporarily on crutches, the person recovering from major surgery, as well as the person who is permanently disabled.

According to Paarlberg (2008) occupant evacuation plans and initial fire department

operations are dependent on the type of construction encountered in a building. Paarlberg listed three commonly used evacuation strategies which are: shelter-in-place, phased evacuation, and full evacuation. Terpak (2002) asserted in fire resistive buildings, such as the AM, BM and HM, fire spread will likely be confined to the apartment of origin and possibly the apartment located directly above the fire. Terpak proposed in these types of buildings, a phased evacuation was appropriate and firefighters should focus their rescue efforts on the fire floor and the floor above. He added that depending on the severity of the fire, using a shelter-in-place strategy for occupants on these floors may be the most appropriate action. McGrail (2007) agreed with Terpak that, when appropriate, a shelter-in-place strategy should be used. McGrail added it is critical this strategy be communicated to the occupants during pre-planning and training and more importantly during a fire incident. McGrail also noted that a shelter-in-place strategy should only be considered after a thorough evaluation of conditions. The presence of fire extension or the exposure of occupants to smoke would dictate the occupants be removed to a place of refuge. Dunn (2003) in addressing the obstacles faced by fire departments with limited manpower, proposed that moving people horizontally within a building to a place of refuge may be the best option for achieving life safety. Dunn listed places of refuge as fire stairwells on the fire floor that are clear of smoke, apartment units on the fire floor that are well removed from the fire, and other areas protected from smoke and heat by a building's fire control systems. In non-fire resistive buildings such as the SM, however, a different evacuation strategy must be utilized. Terpak (2002) stated these buildings require a full evacuation of the occupants from the effected fire floors and possibly the entire building depending on the severity of the fire.

It was apparent from the literature review that it is imperative occupants understand what actions they should take in the event of a fire or fire alarm activation. McGrail (2007)

stated “the evacuation of occupants from a building should only require direction from fire department personnel, with little or no hands-on assistance. For those occupants who do need hands-on assistance, that falls under the category of removal or rescue” (p. 231). McGrail suggested evacuation plans should require occupants who are capable of self evacuation to begin the evacuation process. This will allow firefighters to focus their attention on the elderly, physically disabled, and non-ambulatory occupants who need assistance. McGrail also stressed those occupants who shelter-in-place must be instructed on the proper actions they should take. Placing a towel at the base of their apartment door to limit smoke spread, hanging a light colored article of clothing or material from their window or balcony, or if trapped in a hallway, moving horizontally to a protected stairwell were some of the options given.

Another behavior that must be addressed by a building’s evacuation plan is what occupants should do if they encounter smoke along their evacuation path. Both Proulx (2003) and Bryan (2003) agreed there is evidence suggesting people will move through smoke in an attempt to reach safety. Research conducted by Proulx (2003) indicated people will move through smoke until the visibility is reduced to less than ten feet. Bryan (2003) claimed an occupant’s knowledge of the location of exits, the travel distance to the exits, and the presence or absence of heat will play a determining role in whether they will choose to enter a smoke filled environment. According to Proulx (2003) this behavior resulted in the deaths of six occupants of a residential high-rise structure in 1995. The victims all succumbed to smoke inhalation while attempting to evacuate down smoke filled stairwells instead of exiting the stairwells to floors that were clear of smoke. Both authors agreed occupants must be taught to avoid smoke filled environments by choosing alternative exit routes or sheltering in place.

In summary, there are many factors that contribute to how people will react during a fire

or fire alarm activation. A building's accessible egress paths, type of building construction, fire alarm system design, number of previous fire alarm activations, and accommodations for those with disabilities must be considered. Likewise, it was shown that some people will react inappropriately to the sound of an alarm. Studies showed that instead of moving to a place of safety, people will look for additional confirmatory information, seek the input of others, gather belongings, enter smoke filled environments, ignore the alarm altogether, or at the very least, delay their evacuation movement. Encouraging, however, was the message that proper evacuation behavior can be achieved through training and development of an evacuation plan.

The impact of the literature review on this research project was threefold. First, an evaluation of each HAGH manor was performed to determine if building and fire alarm system design were negatively impacting the occupants' ability to evacuate. Second, the negative occupant behavior in response to fire alarms identified by others was used in the development of the occupant survey used in this research to determine if similar behaviors were occurring in the HAGH manors. Finally, the current evacuation plan for each HAGH complex was evaluated and will be compared to the various types of evacuation plans and evacuation strategies discussed in this section.

Procedures

Descriptive research, utilizing a semistructured survey administered to the occupants of the HAGH manors, was performed to gain insight into the occupants' current knowledge of and compliance with evacuation procedures, determine the reason why some occupants were not evacuating, and identify the physical or personal barriers preventing some occupants from evacuating. Also, the AFD and HFD NFIRS databases were accessed to determine the cause and frequency of fire alarm activations at the four manors.

Prior to selecting this topic for my Applied Research Paper for the Executive Analysis of Community Risk Reduction course, the Chief Operations Officer of the HAGH was contacted via telephone to apprise him of the project, obtain permission to conduct research involving the HAGH occupants and HAGH facilities, and to gain insight into what he considered to be the greatest challenge in providing for the safety of the occupants. The request was met with enthusiasm and it is worth noting that the support from the HAGH staff was invaluable throughout the research project.

During the development of the occupant survey, this researcher met with the Chief Operations Officer to obtain information on the four HAGH manors used in the study as well as obtain copies of HAGH policies that related to fire alarms and evacuation procedures. The method of survey dissemination was also discussed and it was determined that face-to-face interviews with the occupants would yield the highest response rate. One month prior to conducting the surveys the final draft of the occupant survey was presented to the Chief Operations Officer and received approval. Two weeks prior to the scheduled survey date for each manor the HAGH posted fliers throughout the common areas of each manor announcing the purpose of the survey and requesting the occupants' participation (see Appendix A).

Information obtained from the HAGH indicated there were 281 occupants residing in the four manors being surveyed. To accomplish the surveys a survey team was formed to administer the face-to-face surveys. The team included ten firefighters and the author of this research paper. Eight firefighters were used at the Aberdeen Manor, six at the Broadway Manor, and four each at the Hoquiam and Skyview Manors. The number of firefighters assigned to each manor was designed so that each firefighter would be limited to ten to fifteen surveys to allow time for good occupant interaction. Prior to administering the surveys, the survey team was presented with the

survey to discuss the content and format. It was stressed that the intent of the survey instrument was to discover the current behavior and attitudes of the occupants and that there was not a right or wrong answer. Specifically, the team was instructed to avoid having the occupant answer what they thought was the correct answer instead of providing information about their current behavior. The team was also instructed to use a semistructured survey format that allowed them to clarify an occupant's response when necessary. Each manor was visited once during the first two weeks of January 2011 with the surveys starting at 1700 hours to facilitate participation by those occupants that worked during the day.

A cover letter describing the goals and objectives of the research project was presented to each occupant at the time the survey was administered (see Appendix B).

The occupant survey (see Appendix C) consisted of seventeen questions that required the occupant to respond either yes, no, or provide a short narrative response. All surveys were completed by the firefighters conducting the interviews based on the information received from the occupant. It was made clear at the time of each survey that all information obtained would remain anonymous as to individual respondent.

Questions 1 through 6 of the survey were used to obtain demographic information specific to each manor. This information was deemed important to identify high risk age groups, length of residency, gender, and the apartment floor they resided on. Questions 7 through 11 were used to determine the occupant's familiarity with the fire alarm system in their building and to determine what actions they took when they heard it activate. Questions 12 and 13 were designed to illicit detailed information from those respondents who indicated they did not always evacuate their building after hearing the fire alarm. Questions 14 and 15 were used to determine what thought process the occupant had upon hearing the fire alarm system activate. Questions

16 and 17 were used to determine if the occupant recalled receiving training on evacuation procedures and if they knew the location of two stairwells on their apartment floor. The questions used in this survey were derived from reviewing similar studies, input from literature on human behavior in response to fire and fire alarms, and from anecdotal observations made by this researcher based on many years of responding to these complexes. Overall, 200 occupants were contacted to take part in the survey. A total of eleven occupants declined to participate. The remaining 189 occupants who participated in the survey represented 67.3% of the occupants living at the HAGH manors. The participation rate for each manor is shown in Table 1.

Table 1

Occupant Survey Participation Rate

Manor	Total Occupants	Declined	Participated	% Participated
AM	140	6	99	70.7%
BM	67	5	43	64.2%
HM	40	0	25	62.5%
SM	34	0	22	64.7%
Total	281	11	189	67.3%

Limitations

The limitations of this research are consistent with research utilizing surveys as a source of data. The information obtained was self-reported by the occupants based on their recall of behaviors and thought processes in relation to past events. This limitation was not as significant for the occupants of the Aberdeen Manor who had experienced a number of fire alarm

activations and could therefore base their answers on recent events. It was a significant limitation for those occupants residing in the Hoquiam and Skyview Manors as the frequency of alarm activations for those complexes was minimal. This limitation applies to questions 7 through 13 of the survey which required the occupant to draw from past experience with fire alarm activations to answer the questions. It was found that for those occupants unfamiliar with fire alarm activity, the common response was they would leave their apartment and building upon hearing the alarm system. While this finding documents the desired behavior from occupants during a fire alarm, it is not known how many would in fact evacuate during a real event. The data obtained from the surveys represents the views and opinions of the occupants present at the time the surveys were conducted. As such, it should only be construed as representing one moment in time, subject to change, as occupants move in and out of the manors. While this survey data will be used to develop recommendations for the HAGH manors, the data and corresponding recommendations should not be considered transferable to occupancies with different building designs and occupant demographics. Finally, it is not known what impact, if any, using a survey team had on the results. Each survey team member received instruction on how to conduct the interview but individual bias and style may have impacted some results.

Results

The data obtained from the occupant surveys was entered into a Microsoft Excel spreadsheet and is presented here in narrative format. Where applicable, the data for each manor is presented separately to facilitate inter-facility comparison.

To address the research question that sought to determine the cause of fire alarm activations and to develop an understanding of the occupants' exposure to fire alarms, a five year database search using AFD and HFD NFIRS incident information was performed for each of the

four HAGH manors. The alarm activations were grouped into five categories: System malfunction, Unintentional system activation, Structure fire, Cooking fire confined to container, and Malicious false alarm. The data showing the number of fire alarm activations for each manor by NFIRS type is shown in Table 2.

Table 2

HAGH Manor Fire Alarm Activations: By NFIRS Incident Type

Manor	735	745	111	113	714	Total
AM	4	6	3	4	7	24
BM	1	4	0	5	5	15
HM	2	1	0	5	1	9
SM	0	0	0	2	0	2

Note. 735 = System malfunction, 745 = Unintentional system activation, 111 = Structure fire, 113 = Cooking fire confined to container, 714 = Malicious false alarm

Examination of the data indicated the AM had the highest incidence of malicious, system malfunction, and unintentional fire alarm activations. It should also be noted that in January, 2011, during the week following the door to door survey of the occupants of the AM, seven malicious false alarms were received from that complex. That data is not included in this research. Also noteworthy is the AM was the only complex that experienced apartment fires, NFIRS 111, during the five year period. The data also indicated all of the manors had incidents of cooking fires confined to the container. It was also found that fire alarm system malfunctions at the BM, HM, and SM were not prevalent. A review of the unintentional fire

alarm activations revealed they were due to system tests and building maintenance procedures that accidently activated the fire alarm systems.

To further gauge the impact alarm activations had on occupant behavior, the frequency of alarm activations over the past five years using the five NFIRS types are shown in Table 3.

Table 3

Frequency of Fire Alarm Activations

Manor	2006	2007	2008	2009	2010	Total
AM	10	4	1	1	8	24
BM	0	5	3	4	3	15
HM	3	2	2	2	0	9
SM	1	0	1	0	0	2

A review of the data indicated the eight alarm activations at the AM in 2010 were due to five malicious false alarms, one cooking fire confined to container, an unintentional activation, and a system malfunction. The AM alarm activation in 2009 was for an apartment fire caused by unattended cooking. The AM alarm activation in 2008 was caused by a cooking fire confined to container. The four AM alarm activations in 2007 were due to two malicious false alarms, a cooking fire confined to container and an unintentional activation. The ten AM alarm activations in 2006 were from two apartment fires from unattended cooking, four unintentional activations, three system malfunctions, and one cooking fire confined to container. For the BM in 2010, the three alarm activations were due to a malicious false alarm, an unintentional activation and a system malfunction. For the BM in 2009, the four alarms were from two unintentional

activations, a malicious false alarm and a cooking fire confined to container. In 2008 the BM had three alarms, two from malicious false alarms and one unintentional alarm activation. In 2007 the BM had five alarms with four due to cooking fires confined to container and one malicious false alarm. The BM had no activations in 2006. The HM did not have any alarm activations in 2010. The HM had two activations in 2009, both for cooking fires confined to container. In 2008 the HM had two alarm activations, one due to a system malfunction and the other an unintentional activation. In 2007 the HM had two alarm activations, one due to a malicious fire alarm and the other a cooking fire confined to container. In 2006 the HM had three alarms, two due to cooking fires confined to container and the other a system malfunction. The two alarm activations at the SM during the five year period were from cooking fires confined to container.

This data was important because of the linkage established between the number of false alarms and resulting poor compliance with evacuations addressed in the literature review. Results presented later in this section will show the negative impact false alarms had on evacuation movement and occupant behavior at the HAGH manors. Also striking was the data which showed there were 16 alarm activations from cooking fires confined to container. Most were caused by unattended cooking, a risky behavior that must be addressed by the HAGH and fire departments.

The occupant demographics for each manor were collected to identify high risk age groups, gender, length of residency, apartment floor, and whether they lived alone. The number of years an occupant resided in their building was collected to ascertain their past exposure to fire alarm activations. The data also provided insight into the transitory vs. permanent nature of occupant residency. The majority of occupants in all four manors had resided in their apartments

for longer than three years. It was noted there were occupants in all four manors that had resided in their apartments for longer than twenty years. The length of residency for each manor is shown in Table 4.

Table 4

Length of Residency: All Occupants

Manor	< 1 year	1 to 3 years	> 3 years	n =
AM	16.2%	20.2%	63.6%	99
BM	11.6%	30.2%	58.1%	43
HM	20.0%	8.0%	72.0%	25
SM	13.6%	36.4%	50.0%	22

The floor each occupant resided on was documented to identify those living above the ground floor. It is believed a sufficient number of occupants living above the ground floor participated in the survey to provide insight into the egress behavior of those occupants who must use the stairwells to exit their building during alarm activations. For the AM, 77.8% of the survey participants lived above the ground floor. For the BM, 83.7% of the participants lived above the ground floor. For the HM, 68% of the participants lived above the ground floor and for the SM, 54.5% of the participants lived above the ground floor.

As indicated in the literature review, the elderly are considered to be at greater risk from injury or death from fire and their ability to respond appropriately to fire alarms is decreased due to age related decline. The data indicated all four manors have a significant elderly population. It should be noted the literature referred to age 65 as meeting elderly status, however, this study

did not specifically identify that age group. The percentage of each age group to total population is shown in Table 5.

Table 5

Age Group Categories: All Occupants

	Age in Years					
Manor	20 – 30	40 - 49	50 – 59	60 – 69	70 +	n =
AM	15.2%	11.1%	29.3%	31.3%	13.1%	99
BM	18.6%	11.6%	39.5%	9.3%	20.9%	43
HM	12.0%	4.0%	16.0%	24.0%	44.0%	25
SM	9.2%	13.6%	18.2%	27.3%	31.8%	22

The literature review addressed the impact gender had on response to fires and fire alarms which stated that females were generally found to respond more appropriately to the sound of a fire alarm while males often went in search of the fire in an attempt to extinguish it. The data from this survey did not reflect this behavior trait. At the AM and HM the majority of males and females reported they sought additional information before deciding to evacuate. The data for the BM and SM indicated the opposite was true with the majority of males and females evacuating in lieu of seeking additional information. The percentage of female to male occupants at the AM, BM, and HM was on average, 60% female and 40% male. For the SM, the percentage was 70% female and 20% male.

The literature indicated people who were alone at the time an alarm activated responded faster and more appropriately than if they were in a group. It was determined that 87.4% of the

occupants in the four manors resided alone. The survey data did not clearly identify if the remaining 12.6% who lived with someone responded differently to alarm activations than the occupants who lived alone. One occupant of the AM indicated he would not leave his wife who was confined to a wheelchair. He indicated they both shelter-in-place when the alarm activates.

To address the research question regarding the identification of personal or physical barriers preventing some occupants from evacuating the following data was collected. The literature indicated that a barrier causing poor response to fire alarm activations could be linked to the occupants not knowing what the alarm sounded like. The survey data indicated the manors with the highest incidence of alarm activations also had the highest percentage of occupants who knew what it sounded like. For the AM, 100% of the occupants reported they knew what the fire alarm sounded like. For the BM, all but one occupant knew what the fire alarm sounded like. The one occupant who did not know reported they had just moved into their apartment. For the HM, all but four occupants reported knowing what the fire alarm sounded like. As with the BM, the four who did not know had recently moved into their apartments and had not heard the alarm activate. This trend held true for the SM with all but eight occupants indicating they could identify the sound of the fire alarm. The eight occupants had moved in after the last alarm activation in 2008. It is not known if the occupants who did know what the fire alarm sounded like could identify it the next time the alarm activates. A review of this data indicated the majority of occupants in the manors were aware of what the fire alarm sounded like in their building indicating this is not a cause of the poor compliance with building evacuation.

Another barrier to compliance with evacuation addressed in the literature was some studies showed that occupants were unable to hear the alarm when they were in their apartments. This was particularly true for buildings that had alarm horns mounted in the common hallways

and not in each room as is the case with the HAGH manors. This did not appear to be a factor for the HAGH occupants. The data indicated that 90.5% of all the occupants could hear the fire alarm while in their apartments. Only three occupants indicated they had a hearing impairment that prevented them from hearing the alarm. The remainder reported they had not heard the alarm activate so they could not answer the question. One occupant with a hearing impairment reported that he depended on his spouse to inform him when the alarm was sounding. The other two reported neighbors notified them when the alarm system activated.

To identify physical barriers to occupant evacuation, the occupants were asked to indicate if they were capable of using the stairwells without assistance to exit the building. Only the occupants living above the ground floor in each manor were included in this data. As previously indicated, the HAGH is compliant with ADA guidelines and therefore, occupants with mobility impairments can be found residing on upper floors in all four manors. The ability of occupants to use stairwells as a means of egress is shown in Table 6.

Table 6

Ability to Use Stairwells as a Means of Egress: Occupants Residing Above Ground Floor

Manor	Able to Use Stairs	Unable to Use Stairs	
AM	83.3%	16.7%	n = 78
BM	91.7%	8.3%	n = 36
HM	76.5%	23.5%	n = 17
SM	91.7%	8.3%	n = 12

The data indicated that of the 143 occupants living above the ground floor who took part

in the survey, 14.7% were unable to use the fire stairwells to exit their building. This figure represents 21 occupants who would require rescue or removal from their apartments by firefighters. Additionally, the literature stressed the constraints imposed by stairs must be considered for those with a temporary disability as well as those with a permanent disability. There is the potential, that at any given time, the number of occupants unable to use the stairs could be greater than the results indicated in this study. This survey did not differentiate between permanent or temporary disability.

The occupants who indicated they were unable to use the stairwells were asked what actions they took when the fire alarm sounded. It should be noted that the AFD has not provided training on evacuation procedures to the occupants of the AM, BM, and SM for at least five years. The Fire Chief of the AFD has published articles in the local newspaper each year describing what occupants should do if they are trapped in their apartments by smoke or fire, but this information did not directly refer to the mobility impaired. The HFD indicated they last provided training on evacuation procedures to the occupants of the HM over four years ago. At that time the message delivered to the occupants of the HM was for all of the occupants to shelter-in-place and wait for instructions from firefighters. Information obtained from the HAGH indicated they too have not specifically addressed evacuation strategies for the mobility impaired. The survey data indicated the majority of occupants unable to use the stairs were sheltering-in-place in their apartments. Those occupants who have apartments with balconies indicated they move to their balcony. There were two occupants who indicated they move to the area of the elevator lobby on their floor and wait for directions from firefighters and two occupants indicated they did not have a plan and were not sure what actions they should take.

To address the research question regarding occupant compliance with evacuation

procedures the occupants were asked if they always evacuated when the fire alarm sounded. The 21 occupants unable to use the stairs are not included in this data which is shown in Table 7.

Table 7

Compliance with Evacuation Procedures: Occupants Capable of Self-Evacuation

Manor	Evacuate	Do Not Evacuate	n =
AM	40.7%	59.3%	86
BM	77.5%	22.5%	40
HM	38.1%	61.9%	21
SM	71.4%	28.6%	21
Total	89 Occupants	79 Occupants	168

Evaluation of the data revealed the AM and HM had the highest percentage of non-compliance with evacuation procedures. This is not surprising data for the AM since the literature indicated false alarms negatively impact the occupants' confidence in an alarm system. It is difficult to explain the number of occupants of the HM who are choosing not to evacuate. The HM did not have any fire alarm activations in 2010 and only two activation per year for 2007 through 2009. What may explain the non-compliance is the alarm activations were for burned food and therefore did not impact the entire building. Another explanation may be the training the occupants received from the HFD to shelter-in-place and wait for instructions. The data for the BM is surprising but encouraging since this manor had the second highest number of alarm activations over the five year period. The data for the SM is encouraging but must be weighed against the fact there were only two fire alarm activations at this complex over the past

five years. During the survey process of this manor, it was noted the occupants often based their answers on what they thought they would do rather on what they actually did since they did not have recent exposure to fire alarm activations on which to base their answers.

To address the research question that sought to determine the occupants' rationale for not evacuating, the occupants were asked what factors caused them to remain in their apartments. The mobility impaired occupants are not included in this data. The responses from the 79 occupants capable of self-evacuation who indicated they remained in their apartments are included here. The majority of these occupants, 74.7%, reported they looked for secondary confirmation in the form of smoke or flames. If they did not detect either they remained in their apartments. Some indicated they knew what burning food smelled like and would stay in their apartment if they considered burnt food the cause of the fire alarm. An interesting finding was that five occupants at the AM and one at the HM reported they checked the fire alarm panel to determine if there was a real fire. What should be noted is the addressable alarm panels only indicate which floor the detector has tripped on and not whether an actual fire is occurring. Less common, but reportable, were the occupants who stated they would not leave if the weather was bad, were busy with a project, or if the fire alarm was at night. Two occupants reported they would not leave their pets behind. These were the only two occupants who cited this as a reason. It is not known if this was not considered by other occupants who owned pets or if they had contingency plans in place. Two occupants reported psychological conditions that prevented them from leaving their apartments unless it was absolutely necessary. This causal factor was not considered prior to conducting this research. Special consideration must be given to this group when developing an evacuation plan. One occupant at the AM reported they did not leave because they knew the apartment walls were fire proof and another AM occupant reported that

he evacuated only if he saw firefighters pulling hose when they got off the fire engine.

The 79 occupants capable of self-evacuation who indicated they often remained in their apartments were also asked to indicate what circumstances prompted them to evacuate. The majority, 78.5%, cited requiring secondary confirmation following the sound of the fire alarm. In this case, the presence of smoke or fire would cause them to evacuate. Comprising 12.7% of the responses were the occupants who reported they would only evacuate if their apartment was on fire. There were some occupants, 10.1%, who reported that they would evacuate only if directed to do so by neighbors or firefighters. Others reported that if they saw other people leaving they would leave too and some reported that they would need to know it was a real fire before they decided to evacuate. These two responses comprised 6.3% and 5.1% of the responses respectively.

To further explore the occupants' rationale for not evacuating, the occupants were asked if they thought the sound of a fire alarm normally meant a fire was occurring in their building. The data is shown in Table 8.

Table 8

Does the Sound of a Fire Alarm = Fire: All Occupants

Manor	Yes	No	n =
AM	26.3%	73.7%	99
BM	41.9%	58.1%	43
HM	40.0%	60.0%	25
SM	50.0%	50.0%	22

It was evident the occupants of the AM had lost confidence in their building's alarm system, most likely due to the significant number of false alarms. The BM and HM data was consistent with information contained in the literature which claimed most people required secondary confirmation in addition to the sound of a fire alarm to validate the cues they were receiving. The ambiguous data from the occupants of the SM could again be because the question required the occupant to draw on past experience with fire alarm activations, making it difficult for the occupant to answer due to their limited exposure.

The occupants who did not believe fire alarms indicated a true fire were further queried to determine why they felt this way. For simplicity, the term false alarm will be used here to represent system malfunctions, unintentional activations, and malicious false alarms. For the AM, 73 occupants reported they did not think the fire alarm indicated there was a fire. Of those, 89% cited false alarms as the reason, 6.8% claimed there had never been a fire, and for the remaining three occupants, one reported the rooms were fire proof, one claimed nobody ever left the building, and one occupant stated that when the fire department arrived the alarm was always silenced. For the BM, 25 occupants did not think the sound of the fire alarm indicated there was a fire. Of those, 92% cited false alarms as the reason and for the remaining two occupants, one felt fire alarms were drills and the other stated they waited to see what the firefighters did once they arrived. For the HM, 15 occupants did not think the sound of the fire alarm indicated there was a fire. Of those, 53% felt the alarms were from burned food on the stove and the remaining 46.7% cited false alarms. For the SM, 11 occupants did not think the sound of the alarm indicated the presence of fire. Of those, 45.5% cited burned food on the stove, 36.5% reported false alarms and for the remaining two occupants, one claimed they thought the alarm was a drill and one stated they just knew there wasn't a fire. This data illustrates the negative impact false

alarms have on occupant evacuation movement. Also notable were the comments by the occupants who ignored the fire alarm if they considered burned food to be the cause. This behavior is troublesome considering the number of cooking related fire alarm activations at each manor and the fact that cooking fires are one of the leading causes of residential structure fires.

To address the research question regarding the occupants' current training on evacuation procedures, the occupants were asked if they had received instructions from the HAGH on what they should do when the fire alarm activated. The data indicated the majority of occupants in each manor did recall receiving instructions. Most reported receiving verbal instructions from the HAGH staff at the time they signed their rental agreement and when they renewed their contracts. Most occupants also indicated they were aware of the evacuation plan posted on their apartment door. Overall, the occupants who recalled receiving instructions stated the instructions were for them to evacuate their building using the stairs when the fire alarm sounded. The responses are shown in Table 9.

Table 9

Received Training on Evacuation Procedures: All Occupants

Manor	Yes	No	n=
AM	61.6%	38.4%	99
BM	81.4%	18.6%	43
HM	76.0%	24.0%	25
SM	72.7%	27.3%	22

A review of this data indicated there were a total of 58 occupants who reported they had

not received instructions on the proper actions to take when the fire alarm system activated. This research did not attempt to determine if some of these occupants had cognitive disabilities that impaired their ability to recall past training. A review of the surveys indicated 30 of these 58 occupants reported they do not evacuate when the fire alarm activates.

The final survey question was used to determine if the occupants knew the location of two fire stairwells they could use to evacuate their apartment floors. This question was asked of all the participants in the survey regardless of the floor they lived on. All of the survey participants living in the BM, HM, and SM knew the location of the two closest stairwells in relation to their apartments. All but two occupants of the AM could identify the two stairwells nearest their apartment. The two occupants who could not identify two stairwells knew the location of the closest stairwell in relation to their apartment. Both occupants were shown the location of the second stairwell at the conclusion of their survey. This data indicated the occupants had a good understanding of stairwell location and this should not be considered a barrier to evacuation movement.

Discussion

Simply stated, one of the objectives of this research was to determine if the HAGH occupants' poor compliance with evacuation movement during fire alarm activations was due to building design issues or human behavior issues. Building design and egress systems were addressed by Chertkoff and Kushigian (1999) who discussed what some described as panic behavior in response to fire incidents. The authors dismissed the notion that panic behavior was common but claimed the behavior displayed was better defined as a heightened state of emotional arousal. Chertkoff and Kushigian stated that during the precondition phase of an event, the occupants may display a heightened state of emotional arousal if there is a lack of

exits, narrow passage ways, or poor knowledge of exit locations. It is the opinion of this researcher that these conditions do not exist at the HAGH manors. Inspection of the manors revealed an adequate number of exits from each floor, wide hallways and emergency stairwells, as well as emergency lighting and exit signs that clearly identified egress paths. Based on the occupant surveys, it was also apparent the occupants had a good working knowledge of exit locations. O'Connor (2005), in referring to panic behavior, stated fire fatalities that occurred in large buildings were often due to the occupants receiving delayed notification that a fire was occurring. During the inspection of the manors it was determined the alarm systems were well maintained and that a sufficient number of detection and notification devices were present to provide for the life safety of the occupants. It is this researcher's opinion that the egress pathways and fire alarm systems in the four manors are adequate, compliant with applicable life safety and buildings codes, and are, therefore, not the cause of poor evacuation movement.

The elimination of building and alarm system design as causal factors of poor evacuation movement leaves only human behavior as the primary determinant of occupant response. This is not surprising as Au (2009) proposed that human behavior is the most important element in emergency response planning since the propensity for humans to adhere to their daily routines and maintain normalcy in their lives contributed the largest delay to evacuation movement.

A positive finding of this research was the determination that 89 of the 189 occupants who participated in the survey reported they evacuated their buildings after hearing the fire alarm. Also noteworthy were the 21 occupants who reported they were unable to evacuate due to mobility impairments. According to the NFPA (2007), 70% of all Americans will at one time experience a disability that prevents them from using stairs and stressed the evacuation needs of people with disabilities must be addressed in a building's evacuation plan. The crux of this

research then was to determine what factors were causing the remaining 79 occupants to ignore fire alarm activations and choose not to evacuate.

Proulx (2007) suggested four reasons fire alarms were not successful in initiating evacuation movement. First, Proulx found some occupants did not know what the fire alarm sounded like in their building. The results of this research indicated 93.1% of the 189 occupants could identify the sound of the fire alarm. The occupants who reported they could not identify the alarm had recently moved into their apartments and had not heard the alarm activate. With only 13 occupants reporting they could not identify the sound of the fire alarm this should not be considered a significant causal factor of poor evacuation movement. The second reason cited by Proulx was some occupants did not know what actions they should take when the alarm activated. This research identified only two occupants who stated they were not aware of an evacuation plan. Both occupants were mobility impaired and unable to use stairs for egress. The third reason cited by Proulx was that occupant exposure to as few as three nuisance alarms in a one year period negatively impacted evacuation movement. The NFIRS data for the AM indicated this manor had seventeen false alarms over the past five years including five malicious false alarms in 2010. The BM had 10 false alarms over the past five years including three false alarms in 2010. The HM had 4 false alarms over the past five years with no activations in 2010 and during the same five year period, the SM did not experience any false alarms. The impact of false alarms on the HAGH occupants was evident when they were asked if the sound of a fire alarm meant there was a fire. For the AM, only 26.3% thought there was a fire. For the BM, HM, and SM the response ranged from 40% to 50% of the occupants reporting they thought the sound of the alarm indicated the presence of fire. Proulx (2007) found that only 25% of occupants considered the sound of a fire alarm to indicate the presence of fire which was

consistent with the results of the AM occupants but not the BM, HM, and SM occupants. Of the 124 occupants who did not think fire alarms signaled the presence of fire, 79.8% cited false alarms as the predominant reason. The other reasons cited by the occupants were burned food, fire drills, or that the rooms were fire proof and therefore fire was not a concern. The fourth reason cited by Proulx to explain why fire alarm systems failed to initiate evacuation movement was the observation that occupants were unable to hear the fire alarms when they were in their apartments. The data from this research indicated this was not a problem at the HAGH manors. Only three occupants reported having a hearing impairment that prevented them from hearing the alarm while 90.5% reported they could hear the alarm when inside their apartments.

The NFIRS data showed there were alarm activations from cooking fires in all four manors during the five year period. Since many of the occupants reported they did not consider the smell of burned food justification to evacuate, it is this researcher’s opinion those occupants may consider alarm activations for anything less than an apartment fire a nuisance alarm. This behavior is consistent with the observation made by Meacham (2009) who reported most people consider the likelihood of fire to be low and the risks negligible, and by Au (2009) who reported the majority of people make incorrect decisions because they have not been exposed to a real fire event. This behavior is dangerous considering the cause of the three apartment fires that occurred within the past five years at the AM were from unattended cooking fires that extended to the entire apartment. This observation is further supported by Ahrens et al. (2007) who reported the leading cause of residential fires was from unattended cooking. The results of this research confirm the observation by Proulx (2007) that false alarms negatively impact evacuation movement and should therefore be considered one of the main causal factors of poor evacuation movement by the occupants of the HAGH manors.

While this research did not discern between daytime or nighttime alarm activations, the observation by Bruck and Tokley (2009) is important to consider. The authors proposed that sleep inertia coupled with the influence of drugs or alcohol can negatively impact an occupant's ability to evacuate at night. This research did not attempt to determine if sleep inertia was a causal factor of poor evacuation for the occupants of the HAGH manors other than to document that three occupants reported they do not evacuate during nighttime fire alarms.

Research by the SFPE (2003) found that gender, age, familiarity with the building, and whether the occupant was alone at the time the alarm sounded were factors determining occupant response to the sound of a fire alarm. The SFPE reported that females generally responded faster and more appropriately. The data from this research did not entirely reflect this behavior. At the AM and HM, the majority of males and females reported their first action after hearing a fire alarm was to seek out additional information. This researcher proposes that the number of false alarms and alarms due to cooking fires had a greater impact on evacuation behavior than gender for these two manors. The data for the BM and SM indicated the majority of males and females reported they immediately begin evacuation movement when they hear the fire alarm. While the behavior for the females at these two manors is consistent with the data presented by the SFPE, the behavior of the males is not. The disproportionate ratio of female to male occupants in these two manors may account for this finding. To address the effect of age on evacuation movement, research by the SFPE (2003) and Miller (2009) reported the elderly were at greater risk from fire and that age related decline negatively impacts the elderly occupant's ability to evacuate due to mobility issues and sensory and cognitive impairments. While this research did not specifically identify an occupant's individual impairment, the data collected did indicate that all four manors house a significant elderly population with 46% of the occupants being age 60 or greater.

According to the NFPA (2007) the special needs of this demographic population must be considered when developing a building's evacuation plan. Familiarity with a building's egress paths was also cited by the SFPE (2003) as being a determinant of occupant behavior. This research attempted to answer this question by two means. First, the length of residency of each occupant was documented to establish how long a resident had lived in their building and to determine their past exposure to fire alarm activations. The data indicated the majority of occupants had resided in their apartments for greater than three years. One could assume that these occupants are familiar with their building's floor plan, systems, and services. This was confirmed by the answers to the second question which asked if the occupants knew the location of two fire stairwells they could use to exit their apartment floors to reach the ground floor. The data indicated that 98.9% of the occupants knew the location of two stairwells they could use to evacuate their building. These two results indicated the occupants possess a good working knowledge of their building's floor plans and egress paths so this should not be considered a barrier to evacuation movement. The final category listed by the SFPE (2003) was the claim that occupants will respond faster to the sound of a fire alarm if they are alone. This research did not collect data that confirmed or refuted this claim, however, it was determined that 87.4% of the occupants in all the manors resided alone. If the observation by the SFPE is correct, the majority of the occupants' evacuation movement should not be delayed by group dynamics.

The literature reported that a common human response to the sound of a fire alarm was to seek out confirmatory clues. O'Connor (2005), Proulx (2007), and Au (2009) agreed that the ambiguous sound of a fire alarm was not sufficient to initiate evacuation movement. The authors reported the cues involved the smell of smoke, the presence of fire, the disruption of a building's services, or the actions of others leaving a building. The data obtained during the course of this

research supported this claim. Of the 79 occupants who reported they did not evacuate following the activation of the fire alarm, 74.7% reported they looked in their hallways for secondary confirmation. Proulx (2007) also reported that many negative evacuation behaviors have been observed by occupants in the form of gathering belongings, looking for family members, or ignoring the alarm altogether. The negative impact of these behaviors was addressed by Kobe et al. (2009) who reported that proper occupant response during the initial phase of a fire is a critical determinant of occupant survival. This research did not directly identify specific negative behaviors other than to document that some occupants routinely checked the alarm panel in their building, would not leave if the weather was bad, would not leave if they were busy with a project, or if the alarm was at night, and two occupants reported they would not evacuate because they have pets. It is this researcher's opinion that the occupants' negative evacuation behavior coupled with the impact of repetitive false alarms are the greatest causal factors leading to the occupants' poor compliance with evacuation movement.

Proulx (2007) reported that negative evacuation behavior and the tendency of some occupants to seek out confirmatory evidence of a fire can be overcome by providing training and education on a building's evacuation plan. To determine what training the occupants have received, the occupants were asked if they had received training on what they should do when the fire alarm activated. The majority of occupants in all four manors indicated they had received verbal instructions directing them to evacuate their building when the fire alarm system sounded. Some of the mobility impaired occupants living on the upper floors indicated they were not given specific instructions on what to do when the alarm system activated. It is the opinion of this researcher that the development and delivery of educational classes to the HAGH occupants that specifically describes what occupants should do would greatly improve

evacuation movement. The training would also formalize what action those with mobility impairments and other limitations should take so the responding fire departments could factor those actions into their response strategies.

Besides identifying the causal factors of poor evacuation movement, the purpose of this research paper was to explore alternative evacuation strategies that addressed each manor's building design and occupant demographics. Paarlberg (2008) stated that evacuation plans and initial fire department operations were dependent on the type of construction encountered. Terpak (2002) agreed and added that in fire resistive buildings fire will most likely remain confined to the apartment of origin and possibly extend to the apartment directly above. Terpak (2002) and Paarlberg (2008) proposed three evacuation strategies that have proven effective for fire resistive buildings such as the AM, BM, and HM. The strategies cited were shelter-in-place, phased evacuation, and full evacuation. Terpak (2002) claimed that a phased evacuation is appropriate in a fire resistive building as it allows firefighters to focus their rescue efforts on the fire floor and the floor above. Terpak (2002) suggested that in non-fire resistive buildings, such as the SM, a full evacuation of the occupants from the fire floor and possibly the entire building must be utilized depending on the severity of the fire since the building itself will not protect the occupants. Depending on the severity of the fire, Terpak (2002) and McGrail (2007) recommended that a shelter-in-place strategy be used if the egress path used by the occupants is blocked by smoke or heat. McGrail (2007) added that before utilizing a shelter-in-place strategy, the occupants must be thoroughly trained on how and when to implement it. The importance of training cannot be over emphasized in addressing occupant behavior during a fire. Both Bryan (2003) and Proulx (2003) reported that occupants will move through smoke in their attempt to exit the building. According to Proulx, this behavior has resulted in occupant deaths from smoke

inhalation. The comments by Dunn (2003) were pertinent to this research because the author addressed the constraints placed on fire departments having limited man-power on the initial response. Dunn suggested that in fire resistive buildings firefighters move occupants horizontally to places of refuge on floors threatened by fire and toxic smoke. This strategy is applicable to the AFD and HFD. The comments by McGrail (2007) regarding occupant evacuation related directly to the limited initial response capabilities of the AFD and HFD. McGrail stated evacuation plans should instruct occupants capable of self-evacuation to immediately evacuate their building if their egress path is clear of smoke and heat, and for the mobility impaired occupants needing assistance or occupants trapped by smoke or heat to shelter-in-place. McGrail added this strategy allows firefighters to focus their attention on those needing removal or rescue.

The current evacuation plan for the HAGH manors directs the occupants to evacuate when they hear the fire alarm activate. This research showed that 89 of the 189 participants are following the plan. The research also indicated that 131 occupants reported they had received instructions directing them to evacuate. It is the opinion of this researcher that the disparity between the number of occupants aware of the plan and the number of occupants not evacuating is due to the causal factors identified by this research. It is also the opinion of this researcher that addressing the causal factors and training the occupants on proper evacuation behavior would substantially improve compliance with evacuation movement.

One of the main causal factors of poor evacuation movement identified by this research was the impact false alarms were having on the occupants. It is this researcher’s opinion that to improve the occupants’ confidence in the alarm systems several objectives must be met. First, system maintenance must be ongoing to reduce the incidence of system malfunctions and

controls set in place to reduce the incidence of unintentional activations. Second, the reduction of malicious false alarms must continue to be a priority for the HAGH and responding fire departments. Possible solutions include education, engineering controls, and enforcement. It was reported earlier in this paper that multiple false alarms occurred at the AM after the occupant survey was conducted. It is believed they were brought to a halt by the increased presence of fire department and law enforcement personnel as well as intervention by the HAGH staff. To offset the negative impact of cooking fires, education must be provided to promote safe cooking practices to reduce the incidence of stove top fires.

Implications

The organizational implications of this research project to the AFD are substantial. This research utilized the Community Risk-Reduction Model presented in the EACRR course as a blueprint to analyze the risks, hazards, and vulnerabilities facing the occupants of the HAGH manors. The model proved to be an effective risk analysis tool and the AFD will be integrating the model into future risk analysis programs. Additionally, the research successfully identified several causal factors of poor evacuation movement including the impact of false alarms, the challenges faced by the mobility impaired, and the occupant's behaviors and attitudes that were producing negative evacuation behavior. These factors will be applied to Step III of the Community Risk-Reduction Model to develop interventional strategies that will improve the occupants' compliance with evacuation movement. The goal will be to develop an effective evacuation plan for each manor that addresses each building's unique design and occupant demographics. Finally, this research briefly touched on alternative evacuation strategies and tactics that should be considered by the responding fire departments and HAGH. A critical point brought forth in the literature was that emergency responders, occupants, and building

management must work together to create the evacuation plans so that each group is aware of their roles and responsibilities should an emergency incident occur.

Recommendations

This research has identified the causal factors creating poor evacuation movement in the HAGH manors. The following recommendations are offered to improve the overall safety of the occupants and improve evacuation movement. Where recommendations include the provision of education and training to the HAGH occupants, this researcher as well as the Aberdeen and Hoquiam Fire Department's Public Education Teams will need to develop targeted life safety curriculum that will then be presented to the occupants of all four manors by fire department personnel.

Fire alarms resulting from system malfunctions, unintentional activations, and malicious false alarms were the primary cause of the occupants' negative evacuation behavior. To reduce the number of alarms due to system malfunctions it is recommended the HAGH continue to place a priority on its current preventative maintenance program. The NFIRS data indicated that maintenance and system upgrades by the HAGH have decreased system malfunctions in the four manors over the past five years. Unintentional alarms were caused primarily from activities such as painting, cleaning, occupants smoking in the hallways, or not placing the alarm system in test mode during testing or maintenance procedures. To reduce unintentional alarms, HAGH staff and private contractors must be instructed to cover smoke detectors with an approved dust shield if their activity produces dust or aerosols that could activate the alarm system. HAGH staff and alarm system technicians must also ensure the system is in test mode prior to performing system maintenance to prevent unwanted transmission of the fire alarm throughout the building. Finally, to eliminate fire alarms from cigarette smoke, on-going education and enforcement of

the HAGH's policy of not smoking in the hallways must be aggressively enforced. To reduce the number of malicious fire alarms, a cooperative effort involving the HAGH occupants and staff, the members of the AFD and HFD, and law enforcement personnel will be required. The fire departments must provide education regarding the negative impact malicious false alarms have on evacuation movement. The occupants must be shown that any programs developed to reduce the incidence of malicious false alarm would require their support and participation. Two areas in which the occupants could make substantial contributions would be monitoring young children when they are in the vicinity of manual pull stations to prevent unwanted activations and notifying authorities when they observe suspicious activity following alarm activations. It is believed the delivery of educational material would help reduce the incidence of malicious false alarms. In addition to educational programs, the HAGH may need to consider engineering controls in the form of closed circuit video cameras or tamper resistant manual pull stations if malicious false alarms continue to plague these occupancies. Finally, law enforcement and the HAGH staff must aggressively prosecute any person caught tampering with or maliciously activating fire alarm systems.

This research also identified that fire alarm activations from cooking fires occurred in all four manors. Since across the United States cooking fires are one of the leading causes of residential fires each year, these alarm activations should be considered a warning sign that unsafe procedures and practices are occurring in the manors. This research also documented that cooking fires are promoting negative evacuation behavior in the manors as a number of occupants indicated they do not evacuate if they smell burned food. To reduce the negative impact of alarm activations from cooking fires and limit the risk of fire or burn injuries, it is recommended the fire departments develop cooking and kitchen safety curriculum for the

occupants.

This research identified negative evacuation behavior in the form of looking for confirmatory information, ignoring the alarm, checking the alarm panel, or waiting in unprotected areas of the building. To mitigate this behavior it is recommended the fire departments develop educational curriculum that stresses the importance of proper evacuation movement and provides training on the protective actions occupants should take if they encounter smoke or heat along their egress path.

The final recommendation is to review the current evacuation plan for each manor. The HAGH and fire departments should work cooperatively to redesign the evacuation plans so that each building's design features and occupant demographics are addressed. Based on the findings of this research, it is recommended the evacuation plans require occupants who can self-evacuate to exit their building upon hearing the fire alarm. Occupants who are mobility impaired or need assistance should be instructed to shelter-in-place and await rescue, removal, or further instructions from firefighters. All occupants should be taught to never enter a room, hallway, or stairwell that contains visible smoke or fire. Once the evacuation plans are developed, the occupants and responding firefighters must be trained on all aspects of the plan so everyone is aware of their roles and responsibilities. When new occupants move into a manor, HAGH staff must provide in-depth training on the evacuation plan that takes into consideration the capabilities and limitations of the occupant. It is further recommended the evacuation plan be posted in the common areas of each manor, such as elevator lobbies, laundry rooms, and meeting rooms, in addition to each apartment, to ensure occupants are well versed in the proper actions and behaviors expected of them.

This research project has resulted in excellent interagency cooperation between the

HAGH and the AFD. It is this researcher's hope the AFD will build upon this success and seek ways to interact with other groups or agencies representing high risk populations.

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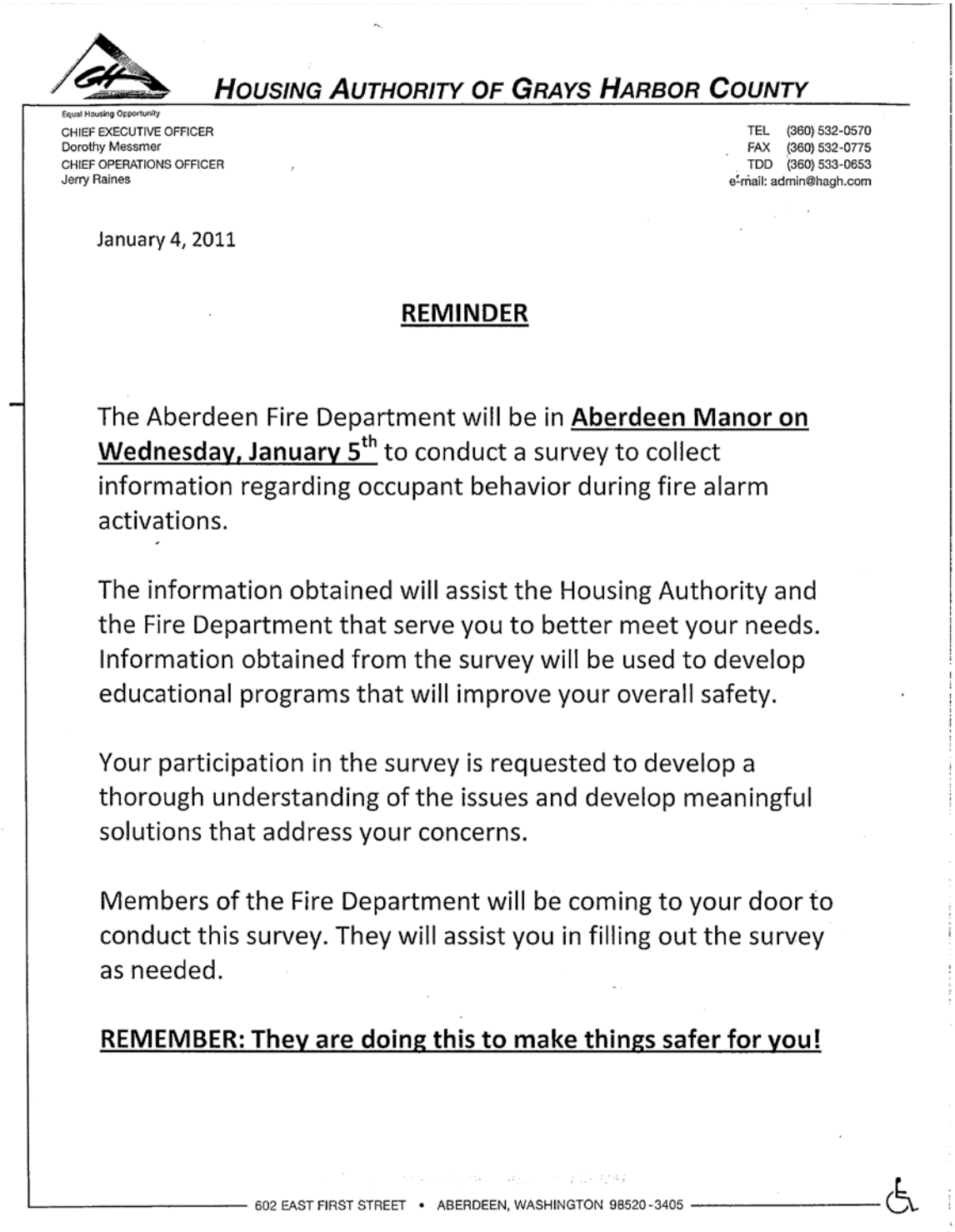
Appendix A

Occupant Survey Notification Flier



HOUSING AUTHORITY OF GRAYS HARBOR COUNTY

Equal Housing Opportunity

CHIEF EXECUTIVE OFFICER
Dorothy Messmer
CHIEF OPERATIONS OFFICER
Jerry Raines

TEL (360) 532-0570
FAX (360) 532-0775
TDD (360) 533-0653
e-mail: admin@hagh.com

January 4, 2011

REMINDER

The Aberdeen Fire Department will be in **Aberdeen Manor on Wednesday, January 5th** to conduct a survey to collect information regarding occupant behavior during fire alarm activations.

The information obtained will assist the Housing Authority and the Fire Department that serve you to better meet your needs. Information obtained from the survey will be used to develop educational programs that will improve your overall safety.

Your participation in the survey is requested to develop a thorough understanding of the issues and develop meaningful solutions that address your concerns.

Members of the Fire Department will be coming to your door to conduct this survey. They will assist you in filling out the survey as needed.

REMEMBER: They are doing this to make things safer for you!

602 EAST FIRST STREET • ABERDEEN, WASHINGTON 98520-3405

Appendix B

Survey Cover Letter

CITY OF ABERDEEN FIRE DEPARTMENT
Dave Carlberg, Fire Chief Rich Malizia, Assistant Chief

January, 2011

TO: All occupants of the GH Housing Authority Manors

Dear Occupant,

The Aberdeen Fire Department, in conjunction with the GH Housing Authority, is collecting information regarding occupant behavior during fire alarm activations at the Aberdeen, Broadway, Skyview, and Hoquiam Manors. The data obtained from the surveys will be included in an Applied Research Project by Battalion Chief Tom Hubbard of the Aberdeen Fire Department. This project is part of the Executive Fire Officer Program at the National Fire Academy located in Emmitsburg, MD.

The information obtained will assist the GH Housing Authority and the fire departments that serve you to better meet your needs. Information obtained from the survey will also be used to develop educational programs that will improve your overall safety while you are a resident of the GH Housing Authority manors.

Your participation in this survey is requested so that we can develop a thorough understanding of the issues and develop meaningful solutions that address your concerns.

If you have questions, please contact the GH Housing Authority at XXX-XXXX or Battalion Chief Tom Hubbard at XXX-XXXX

Battalion Chief Tom Hubbard

Appendix C

Occupant Survey

ABERDEEN FIRE DEPARTMENT OCCUPANT SURVEY
IN PARTNERSHIP WITH THE
GRAYS HARBOR HOUSING AUTHORITY

Your participation in this survey is voluntary and all responses will be kept confidential as to individual identity

1) Which Grays Harbor Housing Authority Manor do you live in?

Skyview Manor □ Hoquiam Manor □ Aberdeen Manor □ Broadway Manor □

2) How long have you lived in your current apartment building?

Less than 1 year □ Longer than 1 year □ Longer than 5 years □

3) On which floor is your apartment located? _____

4) Please indicate your: Age: _____ **5**) Gender: _____

6) Do you live with someone in your apartment? Yes□ No □

7) Do you know what the fire alarm sounds like in your building?
Yes □ No □

8) If the fire alarm sounds, are you able to walk down your building's stairwell by yourself and exit the building? Yes □ No □

9) If you answered ***no*** to the previous question, please write down what actions you take when the fire alarm sounds:
_____
_____
_____
_____
_____

Please continue the survey on the back side of this paper

10) When it is activated, can you hear the fire alarm when you are inside your apartment? Yes □ No □

11) When the fire alarm system in your building sounds, do you *always* leave your apartment and exit the building? Yes □ No □

12) If you answered ***no*** to question number 11, please indicate what factor(s) prompt you to evacuate when the fire alarm sounds:

_____
_____
_____

13) If you answered ***no*** to question number 11, please indicate what factor(s) prompt you to not evacuate when the fire alarm sounds:

_____
_____
_____

14) When you hear the fire alarm system sounding in your building, do you normally think there is a fire? Yes □ No □

15) If you answered ***no*** to the previous question, please explain why you think fire alarm activations in your building are not normally fire incidents:

_____
_____
_____

16) Have you received instructions from the Grays Harbor Housing Authority on what you should do when the fire alarm in your building? Yes □ No □

17) Do you know the location of two (2) different stairwells on your apartment floor that lead to an outside exit? Yes □ No □