Running Head: SEVERE WEATHER PROTECTION PROCEDURES

Determining Severe Weather Protection Procedures for Retirement and Assisted Living Communities in Leawood, Kansas

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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

Within the City of Leawood, KS is a high-density, multi-unit, apartment-style independent-living facility that, because the building is lightweight wood-frame construction, affords little or no protection from tornadoes. This facility is the home for a group of high-risk citizens, many of whom have limited mobility. The problem was the Leawood Fire Department (LFD) did not know how to provide protection for the residents of this community in the event of a direct or indirect microburst or tornado. The purpose of this research was to implement a comprehensive program that effectively identified the best practices for protecting this community and delineated appropriate action to reduce the level of risk to the residents and to reduce liability to the organization and/or community. Descriptive research answered the questions relating to the identification of key risk factors for this community, the limitations to eliminating these risk factors, and the best-practice procedures for protecting the residents in this community. The literature review, interviews of building code professionals, and surveys was used to form an analysis of the procedures currently in use by the facility, methods to improve compliance with the existing plan, and ways to measure the effectiveness of these efforts. The results showed that, although a plan had been in place originally, it was inadequate for the building construction type and many of the residents were either unaware of it, had forgotten, or were experiencing decreased mobility and would require additional time to seek shelter. Recommendations were made to perform an annual tornado drill with monitors in place to measure compliance and times required to evacuate to lower floors.

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Introduction

Severe weather is an unpleasant fact in Kansas and April through June is peak tornado season. Because tornadoes and the storms that produce them are so unpredictable, it is imperative that an adequate warning system be in place. Although storm sirens are strategically placed in the City of Leawood and throughout Johnson County, Kansas, residents must be able to hear the warning in order to seek adequate shelter in a timely manner. Apartment-style, multi-unit retirement complexes have the additional burden of providing a plan for their residents, many of whom may have experienced significant changes in mobility since moving in to the facility. To ensure that each resident understands the best practice for taking cover, action must be taken to identify the current level of awareness, steps necessary to improve residents' response, and develop a better plan if needed. The LFD has considered addressing the subject of tornado drills in this facility and the areas for residents to seek shelter if faced with an actual tornado warning.

The problem is the LFD does not know how to provide protection for the residents of this type of complex in the event of a direct or indirect hit from a tornado. Failure to implement an adequate plan for those residents may result in catastrophic injury or death in our community. The purpose of this research is to implement a comprehensive program that effectively identifies the best practices for protecting this community and delineates appropriate action to reduce the level of risk to the residents and to reduce liability to the organization and/or community. A descriptive research methodology will be utilized to answer the following questions:

1. What are the key risk factors for this community?

2. What are the limitations to eliminating these risk factors?

3. According to experts, what are the best-practice emergency procedures for this type of occupancy?

4. Based on the research, how can the existing tornado plan for this occupancy be improved?

5. How can compliance with the new emergency response/ tornado plan be improved?

6. How can the Leawood Fire Department measure the effectiveness of its effort?

Background and Significance

The State of Kansas ranks third in the nation in number of tornadoes with an average of 49 per year (Kansas Farm Bureau, 2009). The City of Leawood, Kansas is located on the eastern side of the state in a large metropolitan area and shares its eastern border with Kansas City, Missouri. This geographic region in the southern plains of the central U.S. is typically referred to as Tornado Alley, and consistently experiences a high frequency of tornadoes each year. Tornadoes in this region usually occur in late spring and occasionally the early autumn. As reported in the article Tornado Risks and Hazards in the Midwest United States, from 1950 to 2005 there were 3,061 tornado occurrences resulting in 214 fatalities (Federal Emergency Management Agency [FEMA], 2007). Additionally, the State of Missouri experienced 1,604 tornadoes and 200 fatalities during the same period. Given Leawood's location, significant risk exists for the city to be in the path of a damaging tornado.

While the City of Leawood has never experienced a direct hit from a tornado, the possibility exists. An event of that nature could easily exhaust the resources of the LFD, which provides fire, EMS and disaster preparedness response to a city of approximately 30,000 citizens. Recent census information indicates that Leawood is one of the fastest growing communities in Kansas (City of Leawood, 2009). The city, incorporated in 1948, is located in Johnson County, Kansas and is a suburb on the southwest side of Kansas City, Missouri. The entire eastern border of Leawood is the Missouri/Kansas state line and a major eight-lane interstate highway bisects the city. The department covers 14.7 square miles with three fire stations and consists of 57 personnel including full or part-time employees and volunteers. Because of its location, the department has an automatic aid agreement within Johnson County, Kansas and a mutual aid agreement with departments in Jackson County, Missouri. The Department typically responds to over 2,300 calls annually.

Town Village of Leawood is a retirement community that offers independent living options for senior citizens. It is a 188-unit facility divided into 9 pods of four floors each that are connected by enclosed hallways. The central pod houses the administrative offices, dining room, activity areas, and indoor pool. The indoor pool is on ground level and the northern wall is all glass windows. The unprotected stairwells are wood-frame construction, double-layer ½" drywall except for exterior walls, which are single layer. There are two unreinforced mechanical rooms marked SHELTER on each floor next to the elevators.

There are currently 178 residents in the facility occupying 150 (80 percent) of the available units. While most of the residents appear to be in relatively good health with little to no mobility issues, there are several who rely on walkers or motorized chairs to move from one area to another creating a greater need for sheltering space.

James Haynes, Master Code Professional and Building Official for the City of Leawood, Kansas noted that, according to architectural plans submitted for approval in 1999, Town Village exterior is designed to withstand sustained 90 mile-per-hour winds. This rating is within code for requirements for this type of facility, but substantially less than those encountered in a violent tornado, categorized as an F3 to F5, which can range from 136 to over 200 miles-per-hour (Appendix F). The complex was not designed with hardened (reinforced masonry) areas that could be used as storm shelters for the occupants nor is there space to add a safe room in each of the apartments, which are 456 square feet on average.

Building a safe community by identifying and addressing the risks to its citizens should be the goal of every fire department. Reducing risk is the focus of the Executive Analysis of Community Risk Reduction course, R274, and the problem addressed in this ARP directly relates to this theme. The subject also correlates to the United States Fire Administration's operational goals to reduce risk at the local level through prevention and mitigation, improve local planning and preparedness, improve the fire and emergency services' capability for response to and recoveries from all hazards, and improve the fire and emergency services' professional status (USFA, 2009).

Literature Review

The National Weather Service (NWS) rates tornadoes according to the harm left in their wake using the Fujita Damage Scale. Dr. Theodore Fujita, a professor of meteorology, developed the scale that rates tornadoes from F0, for light damage, to F5, for total destruction of buildings (National Oceanic and Atmospheric Administration [NOAA], 2009). Since February 2007, the NWS has used the Enhanced Fujita Scale (Appendix F). In a report based on NOAA Storm Prediction Center statistics, approximately 95 percent of the tornadoes are rated F0, F1, or F2. The number of recorded F3, F4, and F5 in the 2,470 square miles from Topeka, Kansas to Kansas City, Missouri is in excess of 15, making this area one of the most active in the United States (Federal Emergency Management Agency [FEMA] 431, 2003)

FEMA has created an extensive library on the subject of tornadoes and tornado safety. From the initial design criteria for buildings constructed above basic code requirements, known as hardened buildings, to the addition of safe rooms in existing structures, the information is readily available under the heading of wind shelters. A wind shelter is an interior room or other space within a building, or even an entire separate structure, designed and constructed to protect its occupants from high winds associated with tornadoes, or in coastal communities, hurricanes (FEMA, 2002). FEMA also categorizes wind shelters as either residential safe rooms or community shelters. The residential safe room is typically a small, specially designed room, such as a bathroom or closet, intended to provide a place of refuge only for the people who live in the house. The room can be above or below ground. Community shelters are intended to provide protection for a large number of people, anywhere from 12 to as many as several hundred, usually built within or near large public, institutional, or commercial buildings such as schools, hospitals, and nursing homes.

A risk analysis should performed by managers or administrators to determine (a) the likelihood that a tornado will occur and (b) the potential severity of the event. If a building is determined to be at sufficient risk, it is critical to identify the safest areas of the building. FEMA's publication on tornado protection refers to these areas as the best available refuge (2003), which refers to areas in an existing building that have been deemed by a qualified architect or engineer to likely offer the greatest safety for building occupants during a tornado. The area should be large enough to accommodate the number of people who normally occupy the building. People sheltering in the best available refuge areas are less likely to be injured or killed than people in other areas of a building. It is important to note that the occupants may still be injured or killed if these areas were not originally designed as tornado safe rooms. The possibility that a tornado will strike a building is a matter of chance and tornado damage to buildings is predictable (FEMA 431, 2003). A qualified architect or structural engineer should assess an existing building and identify the best available refuge areas (FEMA, 2003).

The Wind Science and Engineering Research Center found that in buildings hit by tornadoes, the threat to life is due to a combination of effects that occur at almost the same time. Wind-induced forces, changes in atmospheric pressure, and debris all contribute to the damage (Texas Tech University, 2009). The Center found some tornadoes generate wind speeds so great that designing for protection is beyond the scope of building codes and engineering standards. Overhangs, canopies, and eaves tend to catch the wind and fail, resembling a sail in extreme winds. The pressure outside a building during a tornado is initially very low in comparison to the pressure inside. The combination of internal pressure and outward pull on the building from suction pressure can cause building failures that force the walls outward and give the building the appearance of having exploded. Debris from damaged buildings and other objects located in the path of the winds can be picked up and carried by tornadoes. Even massive objects such as cars, tractor-trailers, and buses can be moved by extreme winds and cause collateral damage to buildings. Lighter objects become missiles traveling vertically or horizontally and can penetrate doors, walls, and roofs (Texas Tech University, 2009). In his article titled Wind Safety of the Building Envelope, Smith (2009) found that except for window breakage, well designed, constructed, and maintained office buildings should experience little if any damage from weak tornadoes. Smith also found that because many office buildings have wind-resistance deficiencies, weak tornadoes often cause building envelope damage. Most office buildings experience significant building envelope damage and damage to interior partitions and ceilings if they are in the path of a strong or violent tornado.

Unless a building is specifically designed as a shelter or safe room, a direct hit from a tornado ranked F4 and F5 in the Fujita scales will cause catastrophic damage. The maximum wind speeds associated with these tornadoes greatly exceed the wind speeds that most buildings were designed to withstand, resulting in complete destruction during these events. Since most tornadoes do not produce the winds of a violent tornado, some areas of many buildings survive without catastrophic damage or collapse (FEMA, 2003). The FEMA report also found that the best way to reduce the risk of injury and death to the building's occupants is to place them in the best available refuge areas within a building.

Another way to reduce the risk of injury and death from severe storms is early warning. In addition to the Emergency Alert System and emergency notifications from local media outlets, 177 sirens are strategically placed throughout Johnson County, Kansas to warn the citizens of potential danger. The cities, including Leawood, own and maintain the sirens within their jurisdiction. The outdoor warning system is activated to alert the public when the NWS issues a tornado warning for Johnson County, or if a local public safety official or certified spotter reports a tornado. The outdoor warning system is tested on the first Wednesday of the month at 11:00AM unless there is potential for severe weather (Johnson County Emergency Management [JCEM], 2009). From 2005-2009 there were six tornado warnings issued for Johnson County and eight for the surrounding counties with an average lead time of 14 minutes for all events (Iowa State University Department of Agronomy, 2010).

The NWS has verified there was a delay in the outdoor warning system for the tornado that devastated Greensburg, Kansas on May 4, 2007, and reports that NOAA weather radios are a better warning method than outdoor warning systems (Nebraska Emergency Management

Agency, 2009). JCEM strongly encourages the use of the NOAA weather radios and, through a joint initiative with local emergency managers, makes the radios available through a local grocery chain for a considerable savings over the regular price. Unlike outdoor sirens, the weather radios save lives by alerting people who are indoors when severe weather approaches. They can also alert people in homes, schools and businesses to other types of emergencies. The radios provide constant, useful and up-to-date weather information and are equipped with a special alarm tone that will sound an alert and give immediate information in a life-threatening situation. Citizens who are hearing and/or visually impaired can also get the warnings by connecting weather radios to other attention-getting devices such as strobe lights, pagers, bed-shakers, personal computers and text printers (National Weather Service, 2009).

Procedures

The research began in the Learning Resource Center (LRC) at the National Fire Academy in Emmitsburg, MD. Books, journals, internet, and other written sources dealing with tornado shelters and severe storm protection were consulted. This review included computer-aided keyword searches of the LRC on-line card catalog using the keywords “Tornado Shelters”, “Shelter in Place”, Emergency Management”, “Tornado Fatalities”, “Elderly Disaster Victims”, and “Risk Evaluation”. The search brought extensive results and much time was spent narrowing the scope of information. Journals found were of limited use because most of the information dealt with existing shelters or constructing new shelters. They were located on the second floor of the LRC in room 201. Internet research also provided a vast amount of information using the “Google Scholar” search engine and the majority of the literature was acquired via electronic media. As tornado research is an ongoing process, new information and studies are available online.

Upon completion of the literature review, the author focused on research questions one and two that asked about the key risk factors identified for this community and the limitations to eliminating those risks. To substantiate the findings of the literature review, the author conducted interviews with building and codes officials employed by the City of Leawood, Kansas. The author selected Eirene Oliphant because of her expertise as a Master Codes Professional and her position as Chief Building Official. James Haynes, retired Master Codes Professional, was the Senior Commercial Building Inspector during the construction of Town Village. The author interviewed the facility director about occupancy rates, the ideal marketing demographic, and the economic health of the industry and the likelihood they would take on the project of reinforcing areas of the buildings.

For the third research question, which focuses on best-practices for emergency procedures in this type of occupancy, the author sent questionnaires to three local assisted living facilities inquiring into their tornado sheltering procedures (Appendix B). The FEMA reports and documents were quite comprehensive in best-practice procedures for sheltering occupants in large buildings. The responding facilities were similar in their responses, although the building construction differs dramatically.

The author incorporated survey instruments to assist in answering research questions four through six that dealt with improving the existing tornado plan, improving compliance with the new plan, and measuring the effectiveness of our effort. The pre-drill survey can be found in Appendix B. The author divided the survey into four general areas: how does the resident stay informed in the event of severe weather; is the resident aware of the existing tornado plan; would the resident participate in a tornado drill; where would the resident likely take shelter. The author prepared 150 surveys and facility management assisted in distributing one to each occupied unit. Appendix D is a script for the tornado drill that was prepared for participating staff and fire crews to follow. Appendix E is the post-drill survey. Ninety pre-drill surveys were returned (sixty percent) and 138 (ninety-two percent) of the post-drill surveys were returned.

Limitations included the vast amount of information available from FEMA and other emergency management organizations regarding tornadoes and severe weather. Though ample data exists for seeking shelter in hardened structures, little is available in the way of defined areas of refuge in lightweight construction facilities of this nature. The author was often referred to generic best-practices for office buildings with minimum wind resistant characteristics. Information was obtained from the Internet and other outside sources. It is assumed that the information found was accurate and complete. The pre-drill survey (Appendix C) and post-drill survey (Appendix E) was sent only to residents of Town Village of Leawood, therefore, the answers are believed to be truthful and unbiased. The procedural questionnaire (Appendix B) is not a scientific sampling of retirement facilities nationwide. The author made the assumption that the information located at the LRC and other sources is accurate and will not purposely mislead the research project.

Results

Research Question 1: What are the key risk factors identified for this community? By the very nature of the facility, the age of the residents is a key risk factor. An elderly person is typically defined as one who is over 65-years-of-age. Age alone does not make one vulnerable, but the likelihood of having special needs with advancing age increases a person's frailty (Fernandez, Byard, Chien-Chih, Benson, & Barbera, 2002). The term frail elderly often refers to an individual's independence that is limited by health-related conditions. It is better defined as one who uses their entire functional reserve to survive and has no reserve left to cope with even the slightest stress (Fernandez et al., 2002). Although facility management was unable to confirm a number, the author observed numerous persons requiring mobility assistance from walkers to motorized scooters. Not only does this indicate the inability of some to respond quickly to a weather emergency, it poses an additional problem of having adequate space when seeking shelter. A second key risk factor is the building itself; wood-framed construction used in residences and in light commercial buildings can be extremely vulnerable to damage from high winds. Buildings with heavy steel or reinforced concrete frames rigidly connected for lateral and vertical strength are superior to buildings that contain load-bearing walls. On the other hand, wood-framed and pre-engineered metal buildings should not be used as tornado shelters (FEMA, 2003). The third key risk factor is the population density, which multiplies the number of casualties in the event of a direct strike.

Research Question 2: What are the limitations to eliminating these risk factors? Without changing the demographics and nature of the business, it is impossible to eliminate all risk associated with the elderly. By creating and practicing a plan that minimizes travel distance and maximizes warning time, the risk of injury from falls or excessive stress can be reduced. Fernandez et al. (2002) maintain that, with the elderly, the increased vulnerability in disasters is directly attributed to impaired mobility, diminished sensory awareness, pre-existing health conditions, and socio-economic constraints.

The risk associated with the building cannot be eliminated without complete modification of the existing structure. Building a shelter as a new building or part of a new building is more efficient and economical than modifying an existing building to meet specific design requirements (FEMA, 2003). The FEMA report states that retrofitting shelter construction involves strengthening an existing room or area of a building to provide the required resistance to wind forces and debris impact. This process involves extensive modifications to the foundation, frame, envelope, connections, and other building components. It may also require modifications necessary to meet access, ventilation, emergency power, and other requirements. Additionally, the internal shelter created through modification must be a separate structure from the surrounding building in order that damage to the surrounding building would not affect the shelter. Retrofitting shelter construction is disruptive to building occupants and more expensive than new construction (FEMA, 2003). FEMA 361(2008) reports that hardening a new building exterior to endure wind speeds of greater than 200 miles-per-hour adds to the cost by 15-20 percent. Likewise, to harden a safe room in a new building increases the cost five to seven percent. In contrast, for the facility to build a community safe room now would cost from $310,000 to $496,000. Based upon a maximum occupancy of 380 people, 10 percent of those in wheelchairs, FEMA P-431 recommends five square feet per adult standing or sitting and 10 square feet per wheelchair for a total of 2,070 square feet (2003).

To eliminate the risk caused by the population density the facility would have to significantly reduce the number of residents. In an interview with Eddie Vergara, Executive Director of Town Village of Leawood, he stated that the goal of the facility is to increase its current occupancy rate from 80 percent to 100 percent.

Research Question 3: According to experts, what are the best-practice procedures for this type of occupancy? Of the facilities responding to the survey in Appendix A, all reported sheltering the residents in restrooms, mechanical rooms, or enclosed hallways on the lowest level if time permitted. If not, those locations on the resident's floor were used instead. No facility answering the questionnaire had an adequate shelter below grade. For wood-framed constructed buildings as Town Village of Leawood, FEMA P-431

(2003) reports that, the safest areas are on lower floors and in the central part of the building. The report also states that reinforced stairwells typically provide the best available refuge, if they have adequate capacity for the occupant load. The stairwells at Town Village are not reinforced and are exposed to the outside wall with only minimal protection. Restrooms typically provide the next best available refuge areas. All facilities rely on outdoor warning sirens and local media outlets to assist in alerting residents of dangerous weather. One facility placed weather radios in common areas and even incorporated a mass notification system that calls each room immediately with emergency information such as weather warnings from NOAA.

Research Question 4: Based on the research, how can the existing tornado plan for this facility be improved? The author found there was no formal tornado plan in place at this facility. Residents were encouraged to seek shelter in their bathroom or a closet close to the inside wall. Due to several management changes and ultimate ownership change, a formal plan was never adopted. It was clear that a well-organized plan would be an improvement over what was currently in place.

Research Question 5: How can compliance with the new occupant response plan be improved? Based on the results of the survey found in Appendix C, 68 of the 90 residents who answered did not know of a tornado plan for the facility. Sixty-two of those responding stated they would be willing to participate in a drill. Of those who would not participate, 18 of the answers were somewhat fatalistic referring to their age or saying it may just be their time. It was clear from the replies that communication of a new plan is critical to improving compliance.

Research Question 6: How can the Leawood Fire Department measure the effectiveness of its efforts? Once the plan was developed with the cooperation of facility management, copies would be distributed to each resident, posted in common areas and elevators, and additional copies placed in the administrative offices for distribution to new residents. A drill would be planned for early spring in conjunction with testing of the outdoor warning system and weather radio tests. A back-up date would be set in the event the threat of severe weather cancelled the drill. The LFD and Town Village management would conduct the drill and have facilitators in place to answer questions and assist as needed. The timed drill will stop when all participants were in the designated areas. Residents who chose to seek shelter in their apartment would not be included in the time. A post-drill survey (Appendix D) would be sent out to determine the number of participants, where they chose to take shelter, and any suggestions the residents may have to improve the plan.

Discussion

The subject of tornadoes and emergency preparedness for severe weather is one that generates a great deal of interest. The fact that Kansas ranks third in the nation with an average of 49 tornadoes a year and that at least one tornado has been documented in every month is staggering. It is interesting that the average time from warning to strike is less than 15 minutes. With so much evidence attesting to the danger of tornadoes and the damage they cause it is disappointing that more is not done in the way of preparation. When first opened, the facility had a plan for tornadoes, however it was inadequate for the construction type and demographic served. Additionally, as management changed hands over the years the plan had not been revisited to see if changes needed to be made. Weather radios are readily available for a nominal price and yet only one respondent to our survey (Appendix B) had one. There are weather radios in the facility located in the office area and kitchen/dining area. It was encouraging that 39 of the residents answering would be interested in purchasing a weather radio if the facility made them available. The idea of a mass notification system for the facility is an excellent way to alert all residents of the facility immediately.

A walk-through of the buildings revealed long, protected hallways on all floors. Bathrooms in the individual units are along interior walls and could serve as an emergency shelter if needed. Interior stairwells can be used as wind shelters in absolute emergencies, but are not reinforced to withstand violent winds; the three landings are 32 square feet each. Two large restrooms on the ground floor of 40 square feet each are the closest thing to hardened rooms in the structure. Two mechanical rooms per floor have 36 square feet of floor space each. Two trash rooms per floor have 30 square feet each. Based on FEMA P-431 formulas, these areas in total can shelter 121 standing or sitting adults.

The LFD Prevention Division, under the guidance of Fire Marshall Gene Hunter, created a revised tornado plan for the facility. The plan, based on data compiled for this Applied Research Project, was presented to the management group led by Executive Director Eddie Vergara and a date was set to conduct the first tornado drill. Two weeks before the drill informational flyers were placed in the atrium area of the main entrance to the facility and in mailboxes of each residence. The date and time coincided with the testing of the outdoor warning sirens and NOAA severe weather alerting system. Twenty observers were stationed strategically throughout the buildings with instructions to count the number of participants, document which area of refuge the participants chose, answer questions and give directions, and note any comments made by the participants. The drill commenced at 11:00 a.m. and ended at 11:10 a.m. Seventy-five residents participated by going to the designated shelter areas. The longest time reported from activation to arrival was eight minutes. At every shelter area, there were several reports of not being able to hear the siren. The author was in the atrium area and only heard the siren briefly; he was alerted by the NOAA weather radio in the business office. The most surprising result of the drill was that 51 of the participants relied on some type of mobility assistance, from walkers to motorized chairs. The rest, though walking unassisted, appeared slower and more deliberate as they walked.

Recommendations

Based on the information gathered in this research project, the author recommends the LFD consider the addition of an annual tornado drill for Town Village of Leawood, to be performed the first Wednesday of March and beginning in 2011. The drill would be postponed only in the event of the threat of severe weather, whereby it would be rescheduled to coincide with the testing of NOAA weather radios and the outdoor warning system. The author also recommends the following changes to the revised tornado plan:

- Residents on Level 1 – Go to the mechanical or trash rooms in buildings B, D, or E and the restrooms outside the dining room. Overflow should go to the enclosed hallways in building B and the hallway joining buildings D and E. The maintenance shop and trash room on the Garden Level may also be used.
- Residents on Level 2 – It is preferable to seek shelter in the above mentioned areas of Level 1 if possible. If remaining on Level 2 proceed to the mechanical or trash rooms in buildings A, B, D, or E. Overflow should go to the enclosed hallways joining buildings A and B or buildings D and E.

- Residents of Level 3 and Level 4 are highly encouraged to seek shelter in the above mentioned areas of Levels 1 and 2. The top two floors are most vulnerable in a violent wind condition like a tornado. Mechanical or trash rooms on the top two levels, as well as enclosed hallways, should only be used as a last resort.

- All residents are highly discouraged from taking shelter in stairwells at this facility. These are unprotected and are next to the exterior walls. Floor plans will be available with primary and secondary locations color coded for ease of use. An audio recording will also be available for the visually impaired.

The author recommends Town Village of Leawood purchase three additional weather radios to be placed in the common areas on Levels 2, 3, and 4 and in cooperation with the LFD, initiate a program that makes weather radios available to its residents. The LFD would deliver and program the radios for local alerts only to avoid unnecessary activations that result in radios being turned off and defeating the purpose of the program. Finally, the author also recommends the management of Town Village, Leawood, investigate an emergency notification system for the facility that calls the residents to alert them to tornado warnings, evacuations, dangerous conditions, fire, etc.

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Appendix A

Kansas Tornado Statistics

Kansas ranks third in the nation in the number of tornadoes with an average of 49 per year! Tornadoes have occurred during every month of the year. However, statistics show April, May, and June are the peak months for tornado activity in Kansas.

A tornado (from the Spanish "tronada", meaning thunderstorm) is a violently rotating column of air in contact with the ground. If you see a debris cloud under a thunderstorm, the funnel has become a tornado and you need to take cover.

(Source: National Weather Service)

April … May … June

71 % of all tornadoes

93 % of all deaths

88 % of all injuries

Tornado fatalities have occurred as early as March 13 and as late as Halloween.

(Source: National Weather Service)

Worst Tornadoes casualties

1) Udall - May 25, 1955 with 80 deaths and 270 injuries

2) Andover – April 26, 1991 with 17 deaths and 302 injuries

3) Topeka – June 8, 1966 with 16 deaths and 550 injuries

4) Lake Pomona – June 17, 1978 with 16 deaths and 3 injuries

5) El Dorado – June 10, 1958 with 15 deaths and 50 injuries

6) Emporia – June 8, 1974 with 6 deaths and 200 injuries

(Source: National Weather Service)

Appendix B

Dear Facility Manager,

The Town Village management team in cooperation with the Fire Department is planning for tornado season. We want to create the best possible tornado plan for the residents of Town Village, Leawood. In order to do that, we need to draw on your knowledge and wisdom on the subject. ***Your responses will be kept confidential.***

Does your facility have a formal tornado plan for its residents? Yes____ No____

If you answered yes, how are they alerted?

Weather radio____ TV/local media____ Outdoor sirens____ Other____

If you checked other please explain ____

____

Where are the residents sheltered in the event they need to take cover?

Basement____ Enclosed hallway____ Stairwell____ Restroom____ Lower level____

Other____

If you checked other please explain____

____

Do you practice a tornado drill? Yes____ No____

If yes, how often?____

If no, have you ever considered one?

Thank you for your assistance.

Appendix C

Dear Town Village Resident,

The Town Village management team in cooperation with the Fire Department is planning for tornado season. We want to create the best possible tornado plan for the residents of Town Village. In order to do that, we need to draw on your knowledge and wisdom on the subject. We ask that you answer the following questions to help us.

Your responses will remain anonymous.

1. How do you stay informed in the event of severe weather?

Television___ Weather radio___ Other (specify) _______________________

2. Are you familiar with weather radios? (What they are/ how they work?)
   Yes ____ No ____
3. If Town Village made weather radios available for $30, would you be interested in buying one? Yes ___ No ___
4. Are you familiar with Town Village's tornado sheltering plan? Yes___ No___
5. Would you be willing to participate in a tornado drill? Yes___ No___
6. If you answered no, would you tell us why?
   ____
   ____
   ____
7. Where would you go to take shelter? Bathroom___ Closet___ Hallway____
   Trash/Electrical room___ Ground Floor___

Other (please explain) ____

8. Would you need assistance seeking shelter on the ground floor? Yes___ No___

On the back of this sheet, please feel free to share any other thoughts you have about how Town Village should respond to the threat of a tornado.

Thank You,

Battalion Chief Wayne Harder

Appendix D

<u>Tornado Drill Script—March 3, 2010</u>

Monday, March 1st – The forecast is checked to see if stormy weather is likely. If not, the drill is finalized and residents are informed that the drill will take place. (Resident notification plan to include common area posting and notes under the doors.) If forecast indicates stormy weather, the drill is rescheduled for March 10th at the same time. (Alternative signaling plan is used.)

Wednesday, March 3rd at 10::45 – Fire Dept personnel arrive and are briefed as to their roles and observation locations. Simultaneously, T.V. staff is briefed on their roles.

11:00 – All outdoor warning sirens sound, weather radios activate, drill takes place.

11:10 – Drill is complete, residents may return to their apartment.

11:15 – T.V. Staff and F.D. personnel gather to discuss results of the drill.

11:30 – F.D. returns to stations and T.V. Staff returns to normal duties.

March 3 to March 5 – Adjustments made to Tornado plan and published in Emergency Operations Plan for Town Village.

Gene Hunter, Leawood Fire Marshal

913-681-6788 ext. 13

Wayne Harder, Leawood Battalion Chief

913-681-6788 ext. 28

Appendix E

Dear Town Village Resident,

The Town Village management team in cooperation with the Fire Department recently conducted a tornado drill. As we stated in our first questionnaire we want to create the best possible tornado plan for the residents of Town Village. Please take a few moments and answer the questions below. Again, all answers will be confidential.

- I was aware the tornado drill was taking place. Yes_____ No_____
- I heard the outdoor warning siren. Yes_____ No_____
- I was alerted by another means:
  - Weather radio____ Announcement____ Did not hear the alert____
- I participated in the tornado drill Yes_____ No_____
- If you answered yes, where did you seek shelter? Bathroom/closet____ Hallway____
- Trash/Electrical room____ Ground floor____
- Other (please explain)____
- Did you require assistance to seek shelter on the lower floor? ____
- If you answered no, why not? ____

Thank you for assisting us in planning for your safety. Please feel free to use the back of this sheet if you have any thoughts or suggestions for future safety drills.

Appendix F

Enhanced F Scale for Tornado Damage

An update to the the original F-scale by a team of meteorologists and wind engineers, to be implemented in the U.S. on 1 February 2007.

FUJITA SCALE			DERIVED EF SCALE		**OPERATIONAL EF SCALE**	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	**EF Number**	**3 Second Gust (mph)**
0	40-72	45-78	0	65-85	**0**	**65-85**
1	73-112	79-117	1	86-109	**1**	**86-110**
2	113-157	118-161	2	110-137	**2**	**111-135**
3	158-207	162-209	3	138-167	**3**	**136-165**
4	208-260	210-261	4	168-199	**4**	**166-200**
5	261-318	262-317	5	200-234	**5**	**Over 200**

***** IMPORTANT NOTE ABOUT ENHANCED F-SCALE WINDS:** *The Enhanced F-scale still is a set of wind estimates (not measurements) based on damage.* Its uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators listed below. These estimates vary with height and exposure. **Important**: The 3 second gust is not the same wind as in standard surface observations. Standard measurements are taken by weather stations in open exposures, using a directly measured, "one minute mile" speed.