IMPLEMENTATION OF A COMPREHENSIVE SEVERE WEATHER/TORNADO EMERGENCY ACTION PLAN FOR THE UNIVERSITY OF WISCONSIN-STOUT

by

Laura Giede

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The Graduate College

University of Wisconsin Stout

Menomonie, WI 54751

ABSTRACT

Giede Laura A.

(Writer) (Last Name) (First Name) (Middle Initial)

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The purpose of this study was to implement a comprehensive severe weather/tornado emergency action plan for UW-Stout. A review of literature conducted found a four-phased process for identifying and implementing an improved emergency action plan. Emergency action plans of UW-Stevens Point and UW-Milwaukee were compared to the UW-Stout plan to provide guidance in developing an improved plan for UW-Stout. A review of cost justification models determined that loss could be calculated in context with the number of days the university was unable to function. Policy implementation at UW-Stout was also examined. The goals of this study were to:

1. Identify best practices in the development of an emergency action plan.
2. Evaluate various cost justification models for use in the implementation of the current emergency action plan for severe weather.
3. Introduce a redesigned severe weather/tornado emergency action plan for implementation at the University of Wisconsin-Stout.

This study is limited to the geographical location of UW-Stout and the perceived risk and frequency of severe weather based upon historical reports. Time may be a factor in the implementation of the new plan due to unforeseen delays in attaining administrative approval.

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CHAPTER 1: INTRODUCTION

For many years, universities and colleges have been subjected to natural disasters including the effects from severe storms and tornadoes. In order to save lives and decrease the financial burden of these institutions, a comprehensive emergency action plan should be in place. The purpose of an emergency action plan is to organize employer and employee actions during a time of emergency.

The University of Wisconsin system is a state-funded institution of higher learning. Many universities such as UW-Stout are themselves a community. Like communities and municipalities, UW-Stout would benefit from incorporating a severe weather/tornado emergency action plan in order to help reduce losses that can occur during a natural disaster incident. The Disaster Mitigation Act of 2000 was signed into law (Public Law 106-390) by the President on October 30, 2000. The purpose of this law is to provide incentives to state and local governments to develop pre-disaster strategies. Local communities are encouraged to work with the state in planning for the reduction of losses due to natural and man-made disasters.

The University of Wisconsin-Stout is located in the northwestern portion of the state in Dunn County, the city of Menomonie. According to John Enger, representative of University Relations, UW-Stout has approximately 1,200 employees and has an enrollment of 8,000 students. There are 2,700 students who live on campus grounds. The campus covers a total of 115.5 acres and is comprised of 21 major academic and administrative buildings and 11 student service buildings. The coursework offered includes subjects in Applied Science, Art and Design, Food and Nutrition, Industrial

Technology, Vocational Rehabilitation, Human Development, and Hospitality and Tourism. Many areas of the university conduct laboratory courses that require the storage and use of hazardous substances. If an emergency situation such as a natural disaster were to occur, the location and degree of hazard must be considered.

Wisconsin has a history of severe weather and tornado activity. According to the National Weather Service, fact sheets discussing severe thunderstorms and tornado statistics relay that an annual average of 30 days with severe thunderstorms and a 30-year normal of 21 tornadoes occur in Wisconsin in any given year. In Dunn County, between the years of 1951 to 1994, there have been nine tornadoes (Tornado Project Online, 1999). Twenty-one people have been killed and 68 persons have been injured from these weather events. The annual average property and crop damage cost from 1950-1999 in Wisconsin, as reported by the National Climatic Data Center (2001), was 31.33 million dollars. While historic data can not predict the severity of future weather occurrences, it has been noted that the intensity of these tornadoes has ranged between F1 and F5 on the Fujita Tornado Measurement Scale (National Climatic Data Center, 2001, September 12). This measurement scale, generally referred to as the "F Scale", has become the definitive measure for estimating wind speeds based upon the damage resulting from the destruction of buildings, trees and structures. (see Figure 1).

The UW-Stout campus regularly practices fire evacuation drills but has never conducted a planned drill to seek shelter in the event of severe weather such as during a tornado warning or watch. The campus emergency plan indicates that during a tornado emergency one should seek shelter and carry a radio with them. (see Appendix A). There are no clearly marked tornado shelters in any building on campus nor is there a procedure in place that allows the communication of impending severe weather to the building inhabitants. Considering the propensity for severe weather in this area of Wisconsin, an emergency action plan should be implemented to decrease the risk of injury to people and damage to property during a severe weather event.

Purpose of the Study

The purpose of this study was to implement a comprehensive severe weather/tornado emergency action plan for the University of Wisconsin-Stout.

Goals of the Study

1. To identify best practices in the development of an emergency action plan.
2. To evaluate various cost justification models for use in the improvement of the current emergency action plan for severe weather.
3. To introduce a redesigned severe weather/tornado emergency action plan for implementation at the University of Wisconsin-Stout.

Background and Significance

A tornado or severe weather with straight-line winds can occur in Menomonie at any given time as indicated by historical events. In Wisconsin, an average of 30 days of severe thunderstorms and 21 tornadoes occur in any given year. The propensity for tornado activity has been known to increase as well. According to a local television news station, as of July 17, 2004 Wisconsin has experienced 30 tornadoes during the first half of the 2004 tornado season (WCCO Wisconsin News, 7/29/2004).

The most effective means of reducing the risk of tornado-related injuries and possible fatalities is to have adequate warning of approaching severe weather and an emergency action plan in place that the affected population can quickly and easily follow (Weir, 2000).

The University of Wisconsin-Stout has never implemented a drill exercise in which the employees of the UW-Stout community could practice seeking shelter in the event of a National Weather Service reported tornado warning or watch. An improved emergency action plan for severe weather, including the performance of a planned tornado weather emergency drill throughout campus, will help to decrease the risk of injury or possible fatality due to damages that occur during and after a severe storm event. In addition, planning for natural disaster mitigation can help to manage the expected reduction of productivity and morale in employees and students who had been required to seek shelter to assure personal safety. Since UW-Stout is an important part of the Menomonie community, it is expected that they would maintain their highly-respected public image and handle such an emergency with foresight, preplanning and professionalism.

Limitations of the study

Many universities in the United States have an emergency action plan for severe weather including tornadoes based upon their geographical location and the degree of risk involved with the severity of weather events they have experienced.

1. This study is limited to the particular geographical location of UW-Stout and the perceived risk and frequency of enduring a severe weather event based upon historical reports.

2. Time may be a factor in the actual implementation of the new plan due to unforeseen delays in attaining administrative approval.

Definition of Terms

Fujita Tornado Measurement Scale: A six-category scale to classify tornadoes based upon the maximum winds speeds that occur within the funnel, named F0-F5. (National Climatic Data Center, 2001, September 12). (see Figure 1).

Straight-Line Winds: Most of the wind damage that is associated with thunderstorms. There are two categories of straight-line winds. Downbursts are one category and are described as a small area of rapidly descending rain. Derechos are another category and can be defined as an accumulation of many thunderstorm cells. Both are capable of producing wind speeds of up to 150 miles per hour. (National Oceanic and Atmospheric Administration, n.d.).

Figure 1: The Fujita Tornado Scale

Tornado Category	Maximum Wind Speeds	Typical Effects
F0 Gale Tornado	40-72 mph	Light damage. Some damage to chimneys, breaks twigs and branches off trees, pushes over shallow-rooted trees, damage to signboards, some windows broken.
F1 Moderate Tornado	73-112 mph	Moderate damage. Peels surfaces off roofs, mobile homes pushed off foundations or overturned, outbuildings demolished, moving autos pushed off the roads, trees snapped or broken.
F2 Significant Tornado	113-157 mph	Considerable damage. Roofs torn off frame houses, mobile homes demolished, frame houses with weak foundations lifted and moved, boxcars pushed over, large trees snapped or uprooted, light-object missiles generated.
F3 Severe Tornado	158-206 mph	Severe damage. Roofs and some walls torn off well-constructed houses, trains overturned, most trees in forests uprooted, heavy cars lifted off the ground and

		thrown, weak pavement blown off roads.
F4 Devastating Tornado	207-260 mph	Devastating damage. Well constructed homes leveled, structures with weak foundations blown off some distance, cars thrown and disintegrated, large missiles generated, trees in forest uprooted and carried some distance away.
F5 Incredible Tornado	261-318 mph	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate, automobile-sized missiles fly through the air in excess of 300 ft., trees debarked.

(National Climatic Data Center, 2001 September, 12)

http://www.ncdc.noaa.gov/oa/satellite/satelliteseye/educational/fujita.html

CHAPTER II: LITERATURE REVIEW

The purpose of this study was to implement a comprehensive severe weather/tornado emergency action plan for the University of Wisconsin-Stout. In order to implement any emergency action plan, it is necessary to determine what regulations, if any, should be followed. To assure success, the application of best practices was considered in the development of the emergency action plan for severe weather.

It is also important to know what to expect when a severe weather event occurs, the degree of destruction that a severe storm or tornado can produce, and how warning systems are used to communicate the threat of severe weather in order to allow people enough time to protect themselves. Several colleges in the University of Wisconsin system have implemented severe weather planning to include the application of warning systems and the identification of tornado shelters in each building on their respective properties. This study was done to decrease the vulnerability of University of Wisconsin-Stout students, employees and properties to the risks posed when the threat of severe weather or tornado is eminent.

Characteristics of a Tornado

Tornadoes are the most violent weather-related natural hazard in the world (Bohonos and Hogan, 1999). Canada and the United States experience the world's most severe tornadoes. They usually develop from severe thunderstorms caused by the cool northern air masses combining with the warm moist air from the Gulf of Mexico (Weir, 2000 and FEMA, 2003, March 5). In general, agricultural areas such as the midwestern

United States, tend to be at higher risk for tornado development because the weather patterns that promote good crop yields may also contribute to the development of tornadoes (Lillibridge, 1997). The frequency of tornado occurrence differs within a given 24 hour period. Approximately 60% of the tornadoes occur between noon and sunset, 21% from sunset to midnight, and 19% from midnight to noon (Bohonos and Hogan, 1999).- The occurrence of tornadoes in the United States for the years 2001, 2002, and 2003 average to a reported number of 1195. Of those reported and confirmed, 23 tornadoes were classified as killer tornadoes producing an average of 49 fatalities for the previous three years indicated (NOAA, 2004). Between the year 1950 and 1994, over 4,115 fatalities and 70,063 injuries were reported as a direct result of tornadoes in the United States. Additionally, the economic impact of damage as a result of tornado events during the same time period is estimated at over 20 trillion dollars (Bohonos and Hogan, 1999).

Developed in 1971 by Dr. T. Theodore Fujita of the University of Chicago, the Fujita Tornado Scale has become the definitive measurement for estimating the amount of damage sustained from wind generated in a given tornado event. The scale is divided into six categories with category zero illustrating the least damaging effects to category five which depicts the most devastating effects that a tornado can produce (see Figure 1) (National Climatic Data Center, 2001, September). The categories are based upon estimated wind speeds occurring inside the funnel and therefore should not be used literally. The F-scale numbers are estimated and have not been verified scientifically. It is possible that different wind speeds can cause similar-looking damage from place to place (Edwards, n.d. The online tornado frequently asked questions).

Climatologists have determined that tornadoes that have been rated F3, actually have an F3 intensity for about 35% of their track. The remaining 65% of the track, intensity is less than F3. Likewise, tornadoes rated F4 have an F4 intensity for about 24% of their track, and F5 tornadoes have an F5 intensity for approximately 19% of their track.

(Ramsdell and Andrews, 1986). It has been reported that the most severe tornadoes cause the greatest number of fatalities. From 1985-1993, tornadoes ranked F4 and F5 on the Fujita Scale account for only 0.9% of all tornadoes, but are responsible for 52.9% of all tornado-related deaths (Golden and Adams, 2000). In Wisconsin, an average of 21 tornadoes occur annually. The peak season is from May until August, although tornadoes in Wisconsin have occurred in each month except February. They usually emerge between noon and 9 PM. Approximately 80% of Wisconsin's tornadoes have wind speeds of 50 to 110 mph with about 19% of them having wind speeds of 110 to 205 mph with 1% having winds of over 205 mph (NOAA, 2001). Most tornadoes are found near the south or southwest side of a wall cloud of a developing thunderstorm. The wall cloud is the area of a thunderstorm that appears in the lower region, usually rain-free, of the observed cloud. This area is usually rain-free because there is an updraft of air present that pushes air upwards into tall cloud areas. Most thunderstorms over Wisconsin have a cloud characteristic that resembles a funnel shape. If the funnel shape is not rotating or if it does not show signs of persistence then it is probably not a tornado (NOAA, 2001).

In Wisconsin, severe thunderstorms average about 10 to 15 miles in diameter, have a 20 to 30 minute time frame and can produce a great deal of damage. Wisconsin thunderstorms occur on the average of 30 days per year. Of the thunderstorms in Wisconsin 52 percent produce straight-line winds at speeds of 58 MPH or more, 31 percent produce hail that is at least ¾ of an inch in diameter, 7 percent become tornado events, and 5 percent produce flash flooding conditions (National Weather Service, 2003, Severe Thunderstorms).

Straight-line winds usually produce most of the damage associated with thunderstorms. The winds are frequently misinterpreted as a tornado event because of the similar damage and wind speeds produced. There are two categories of straight-line winds. One is called a down-burst which is characterized by a small area of rapidly descending rain and rain-cooled air beneath a thunderstorm. Wind speeds can reach from 100 to 150 miles per hour which is similar to that of an F1 or F2 tornado. These winds usually travel in one direction. Another category of straight-line winds are called Derechos. They are formed when a cluster of thunderstorm cells converge into a solid line for many miles. They can measure from 20 to 65 miles and reach a length of 100 miles or more. Derechos are capable of producing wind gusts of up to 150 miles per hour and have been known to produce small tornadoes. Wisconsin experiences a 100 mile per hour or greater wind event on one day in alternate years (NOAA, n.d.).

According to a newsletter dated July 21, 2004 by the Federal Emergency Management Administration (FEMA), a tornado has caused one death in Wisconsin this year. The year 2004 also marks the 20th anniversary of one of Wisconsin's deadliest tornadoes. In

Barneveld, Wisconsin, a tornado killed nine people and injured 200 on June 8, 1984 according to the FEMA July newsletter. In the years 1954 through 1983, there were 576 tornadoes in Wisconsin. The average length of tornadoes during this period was 6.64 miles, average area was 0.779 square miles, and average width was 0.077miles (Ramsdell and Andrews, 1986). The deadliest Wisconsin tornado, identified as an F5, occurred in New Richmond on June 12, 1899 with 117 fatalities and 200 reported injured. This one is currently ranked number 8 in the top ten United States Killer Tornadoes list (FEMA, 2003 February). In 1958, an F5 tornado occurred in Dunn County, Wisconsin in the town of Colfax. This event happened to be one of four tornadoes occurring in northwestern Wisconsin that day. It injured 110 people and 20 people lost their lives. The estimated cost of damages was in the millions. This particular storm pathway stretched 32 miles long by 800 yards wide (Tornado Project Online, 1999). More recently, and in close vicinity to Dunn County, a tornado touched down in Rusk County on September 2, 2002. The area of destruction was 15 miles long and a quarter mile wide. The economic impact of business loss was estimated at $29.5 million. The clean-up costs could reach over $7 million dollars (FEMA, 2003 June).

According to a UW-Stout campus-wide email sent on July 7, 2004, the Dunn County 911 Communication and Emergency Management Services reported that from 1982 to 2000, Dunn County experienced 63 thunderstorms, of which 36 were classified as severe. Seven of those severe storm events had winds in excess of 75 mph. During this same time period, Dunn County had eight documented tornadoes.

Natural Hazard Warning Systems

The federal agency responsible for issuing weather forecasts and warnings of weather hazards is the National Weather Service. The severe weather watch/warning program's purpose is to provide timely information to the public regarding predicted severe weather. Severe weather watches are issued when atmospheric conditions indicate that adverse weather may impact the population in a specific area. (Belville, 1987). A tornado watch is issued if weather conditions are conducive to the development of tornadoes (Lillibridge, 1997). Severe weather warnings are issued when the National Weather Service has every indication that approaching weather could cause harm to human life and/or destruction of property (Belville, 1987). Tornado warnings are issued when a tornado has been spotted by persons on the ground or by advanced technology. The limitation to the watch versus warning terminology is that the local population may not understand the difference between the two. (Lillibridge, 1997). Severe weather or tornado hazards which pose a threat to people and property require a quick response to avoid catastrophic loss. It is this situation for which warning systems can circumvent loss most effectively.

There have been significant improvements in warnings for tornadoes over the past 25 years. In 1978, the National Weather Service (NWS) was only able to provide warning before a tornado touchdown 22% of the time. In 1998, that ability has increased to 65% with the average lead time for those events of 11 minutes. This increase in warning capability is due to the use of improved radar systems which enable the NWS to become less detective and more predictive in warnings for tornadoes. This capability has assisted in the continued reduction in injuries and deaths due to tornado events (Pielke, R. Jr. and Pielke, R. Sr., 2000).

A warning system should be comprised of more than just sending a message. An intact system incorporates the evaluation and interpretation of the severe weather threat data, the actual conveyance of the message and the type of response that occurs as the result of the warning, which is the purpose of the entire system. Past research has shown that people respond to warnings in a variety of ways. For example, even though several people may hear the same message, there may be apparent discrepancy in what they hear and believe. Secondly, people respond to a warning based upon what they hear and how that information stimulates them to behave and lastly, people are stimulated differently based upon who they are, who is with them and what they can see. The effectiveness of a warning system is demonstrated when the message is received in a clear, concise manner which can be easily understood. The message should be received promptly and contain the information needed for people to make rapid, relevant decisions about appropriate actions. If the person receives the message correctly, he or she must act accordingly and take appropriate action to prevent the loss of life and injury, minimize property damage, and know where a safe area can be reached quickly (Mileti, 1975).

There are two kinds of constraints to an integrated warning system. There are those which delay the development and adoption of the system and those which reduce the effectiveness of the warning system when in operation. Lack of adequate warning and suitable shelter areas contribute to the adverse public health effects of tornadoes (Lillibridge, 1997).

As stated in a July 21, 2004 FEMA newsletter, a convenient and affordable means to receive severe weather information is by incorporating the use of a NOAA Weather Radio (NWR) throughout the university. NOAA Weather Radios broadcast the National Weather Service (NWS) forecasts and severe weather watches and warnings 24/7 on the radio network of the National Oceanic and Atmospheric Administration. NWR is a nationwide service that broadcasts weather information directly from a local National Weather Service office. There are more than 900 transmitters throughout the United States. Broadcasts are made over seven channels at these seven frequencies (MHz): 162.400, 162.425, 162.450, 162.475, 162.500, 162.525 and 162.550 (National Weather Service, n.d.). Each channel covers a three to eight county area. Wisconsin has 32 transmitters that provide excellent coverage to every county. A NOAA Weather Radio can be purchased at most electronics stores and cost between $30-$80 dollars. At the minimum, the radio should have seven channels with an automatic alert system and battery backup (National Weather Service, 2003, Severe Thunderstorms). A personal conversation on November 4, 2004 with the Environmental Health and Safety department at the University of Wisconsin-Stevens Point revealed that they provide these radios at no cost to the entire campus community.

There is another service available at no cost from the Emergency Email Network. They can be accessed through the internet address, http://www.emergencyemailnetwork.com. Their mission is to "Provide notification to citizens of local, regional, national and international emergencies utilizing the Internet and electronic mail (email) in a secure and expedient manner". However, as the NOAA points out, a tornado may take out phone lines or the power to run them. Also, phone lines may become saturated as thousands of numbers are dialed at once (Edwards, n.d., Frequently Asked Questions).

Cost of Severe Weather Communication Devices and Tornado Shelter Signage

After speaking with a Radio Shack customer service representative on November 4, 2004, it was determined that they have two NOAA Weather Radios to choose from that are offered at quantity discounts to educational institutions. Product number 12-259 is the 7-Channel Handheld Weatheradio. It has an auto scan feature that finds the strongest signal, backlit display, 8-level digital volume control, and a belt clip for portability. If UW-Stout were to buy 20 each, the discounted price per radio would be $42.49 for a total of $849.80. If the university bought 50 each, the discounted price per radio would be $37.49 for a total of $1,874.50. The other option is the Bedside Weatheradio Alarm Clock with NWR SAME Operation, product number 12-261. This model has the severe weather alert warning of dangerous weather conditions relayed by voice announcement, tone and status lights (status lights indicate watch, warning or statement), auto or manual weather channel selection, and has digital volume control. UW-Stout could purchase 20 radios at a discounted price of $59.49 for a total of $1,189.80 or 50 radios at $52.49 each for a total of $2,624.50.

Signs that indicate a tornado shelter area can be purchased from Fisher Scientific. The customer service representative on November 4, 2004 offered UW-Stout special contract pricing of $20.62 per sign. There is no price break for a quantity purchase. If the university wanted to begin with placing signage on 20 designated tornado shelter areas, the cost would be $412.40 and for 50 designated tornado shelter areas, the cost would be $1,031.00.

Tornado Preparedness

The prudent approach to improving the Severe Weather Emergency Action Plan at UW-Stout would be to follow the NOAA's National Weather Service guidelines which urge all schools to develop plans to seek shelter and to conduct drills in the event of a tornado in our community. A good tornado safety plan should consider the design of each building and how people are most efficiently moved to designated shelter areas. Ideally, plans would include the most expedient pathway to the lowest level possible in each building. In large buildings, there may not be enough time to move all persons from the upper floors into safe areas. It is best that a customized drill be performed in each building rather than provide a general statement to seek shelter and to carry a weather radio when considering tornado safety for the UW-Stout community. Several things to consider when formulating a plan to seek shelter are that seconds do count. People may not have time to reach a lower floor but a drill can provide information on how to avoid flying debris and to predetermine areas on each floor that are not exposed to windows or walls made of glass. Another consideration, with the help of a professional architectural engineer, would be to determine if the upper floors of each building can withstand the structural stress created by 150 mile per hour and greater winds from any direction. Safe rooms, which are concrete-lined interior rooms, can be retrofitted into existing structures if needed. If portable classrooms are used, the occupants should evacuate to a main building, if possible, before the storm arrives, such as when a tornado or severe weather watch has been issued. Large rooms such as gymnasiums, auditoriums and cafeterias provide no protection from tornado-strength winds. These areas have a wide-span roof design whereby support of the roof structure is only maintained by the outer walls of the structure. The tornado drill should be run several times a year to keep students and staff in good practice and to identify any procedure that would need improvement. The tornado response plan should assign specific persons to accompany students to designated safe zones (Bureau of Construction Codes, 2002). Information should be provided to persons concerning the appropriate precautions to take after a severe weather event has occurred. Reiterate the importance of avoiding downed power lines, staying away from the damaged areas of buildings and that matches and lighters are not to be used under any circumstances due to the possibility of ruptured gas lines (Edwards, n.d., Online Tornado Frequently Asked Questions).

The Environmental Health and Safety department at UW-Stevens Point provides an excellent example of a well-formulated severe weather emergency action plan. Their website contains information mapping out the exact locations of suitable shelter areas on each floor of every building. With the assistance the numerous resources in Dunn County and those of the UW-Stout community, our university would be well on its way to the implementation of a well-planned severe weather emergency action plan.

Regulatory Requirements in Emergency Action Planning

Under the authority of the Wisconsin State Statutes, Chapter 166, the Operations Plan Guidance document,(Wisconsin County Government, 2003) provides direction to Wisconsin counties in planning for the continuity of operations and government. It is suggested that each county have in place a plan that will assure continuous operation of essential functions in light of an emergency situation. Since September 11th 2001, we have become aware of the need to resume business practices as soon as possible. In the event of a natural disaster such as the formation of a tornado involving UW-Stout properties it becomes essential that an emergency action plan exists that can be implemented both with and without warning. As a major public institution within Dunn County, it would be advantageous for UW-Stout to consider the guidelines of the Wisconsin Statutes document.

The government legislation signed by President Clinton on October 30, 2000, identified as the Disaster Mitigation Act of 2000 (Public Law 106-390), emphasizes the importance of pre-disaster hazard mitigation at the state and local level. The purpose of this law is to provide funding incentives to states that have developed a comprehensive, enhanced mitigation plan prior to disaster. To implement Public Law 106-390, the Federal Emergency Management Agency (FEMA) prepared a final interim rule. It was published in the Federal Register on February 26, 2002, at 44 Code of Federal Regulations (CFR) Parts 201 and 206, which establishes planning and criteria for states and local communities. Section 322 of the Act specifically addresses mitigation planning at the state and local levels. To achieve the criteria set forth in Section 322, state governments must prepare and submit a standard or enhanced state mitigation plan, review and update the plan every three years, and provide technical assistance and training to local governments to assist them in applying for the national post-disaster Hazard Mitigation Grant Program (HMGP).

State governments must also provide assistance in the development of local mitigation plans and can review and approve local plans if the state has an approved enhanced plan. (Disaster Mitigation Act of 2000 fact sheet, 2003).

A letter dated September 8, 2004 to all United States governors from Tom Ridge, U.S. Department of Homeland Security, delineates the National Incident Management System (NIMS) requirements. All states are to use the same standardized procedures in incident management when a homeland security incident occurs, whether it is as a result of terrorism or natural disaster. Fiscal year 2005 is the start up year for NIMS implementation (Ridge, T., 2004).

Individual states have amended their fire prevention codes to require tornado drills in all schools, including state supported schools, colleges, universities and school dormitories. For example, according to the State of Michigan's web site, http://www.michigan.gov/printerFriendly/0,1687,7-154--46091--,00.html, as of March 30, 1998, the Michigan state government requires that at least two tornado safety drills be performed annually at all schools. This is not yet a requirement or a fire prevention code regulation in the State of Wisconsin.

Best Practices in Emergency Action Plan Development

There has been a continual increase in disaster-related losses in the United States. In an attempt to mitigate the losses created by the occurrence of natural disasters, state and local governments are adjusting their policies to reflect the importance of reducing damage caused by extreme events. Many government jurisdictions now require that a hazard mitigation plan be in place (FEMA, 2003 August).

The use of best practices in emergency action plan development creates an optimal situation because the overall goal becomes the protection of human life, the minimization of injury and the protection of property. It also serves to minimize liability throughout the period of vulnerability experienced after any disaster (Gustin, 2002). Higher education institutions have realized the importance of becoming more disaster resistant. Administrators, faculty, and staff have realized that improvement in their campus emergency action plan will protect lives and safeguard the areas of instruction, research and public service (FEMA, 2003 August).

The emergency action plan for UW-Stout provides minimal guidelines for persons on campus to follow in the event of a severe weather event. (see Appendix A). The University of Wisconsin-Stevens Point (UW-SP) uses similar guidelines but has included a diagram of severe weather shelter areas available in each building on campus. (see Appendix B). In addition UW-SP provides NOAA Weather Radios to the entire campus community at no charge. The University of Wisconsin-Milwaukee (UWM) emergency action plan provides extensive information about tornadoes and lists the location of shelter areas available in each building. UWM also provides signage, "Tornado Shelter Area", to easily identify these areas. (see Appendix C). As of August 2003, the Federal Emergency Management Agency (FEMA) has provided a disaster mitigation document specifically for institutions of higher learning. "Building a Disaster-Resistant University" was created to offer assistance and guidance to those colleges that wish to incorporate state and local mitigation practices into a university setting. As with state and local hazard emergency action planning, the FEMA document incorporates a four-phased process for identifying and implementing actions to reduce or eliminate loss of life, property, and function due to natural hazards experienced by universities and colleges in the United States. The four phases are identified as Organizing Resources, Hazard Identification and Risk Assessment, Developing the Mitigation Plan, and Adoption and Implementation (FEMA, 2003 August).

The first step, organizing resources, is performed by the disaster planning team. Members of this team should be comprised of individuals from administrative and academic staff as well as student representatives (Modic, 1995) (FEMA, 2003 August). Their duties encompass the creation of a strategic plan that includes resources from on and off campus, selecting a campus leader, forming an advisory committee, and gathering information (FEMA, 2003 August). As far as the university administration is concerned, involvement from the chancellor is paramount in getting others of the university community to accept any changes or improvements to the current severe weather emergency action plan. In addition, there are many established planning committees in the university system. These include buildings and grounds, physical facilities, public service, auxiliary services such as the UW-Stout Day Care Center, public safety such as the UW-Stout police department, environmental health and safety planning and the university telecommunications and information systems planning and development.

The academic portion of the planning committee should integrate the need to maintain continuity of instruction while protecting their investment in research efforts. The Faculty Senate of UW-Stout could assist in the identification of available faculty-based committees. Equally important is the consideration of student affairs by the identification of student services and student-based resources that can assist in the planning process. Some areas to focus upon would be the identification and evaluation of hazards having the greatest potential for disaster (FEMA, 2003August). Furthermore, the disaster planning team should also prioritize the university's vulnerabilities. For example, the communications systems should be kept up and running in order to assure that each affected person is aware of the current situation before, during and after a severe weather event (Modic, 1995).

Another important resource is that of the Menomonie community. Local governmental groups provide experience in dealing with natural disasters and have formulated solutions that serve the community in the best possible way. The Local Emergency Planning Committee utilizes the city and county emergency management services to provide resources about disaster preparedness. The providers who would assist in the maintenance of the community infrastructure include: Dunn County Electrical Cooperative, Excel Energy, Diggers Hotline (800-242-8511), City of Menomonie Wastewater Plant, Street Department, Water Department, Fire Department, Police Department and the American Red Cross-Dunn County Chapter. Each of these providers should be apprised of the UW-Stout Emergency Action Plan so that, if needed, the university could depend upon Menomonie community resources in the event of a severe weather event such as a tornado (FEMA, 2003 August). Specific strategies are necessary to reduce the impact of the disaster upon daily operations. A useful plan can be identified as having strategic importance to employees, students, and the community in general (Gustin, 2002). For example, the University of Miami works with the Miami-Dade Office of Emergency Management to improve its own and the community's disaster resistance. The University of Miami Director of Environmental Health and Safety serves on the Local Mitigation Strategy Steering Committee and contributes to the local government's mitigation planning activities. By working with the local government, the University of Miami has been able to utilize all of the potential resources that the local, state, and Federal agencies have to offer (FEMA, 2003 August). Similarly, UW-Stout has a Crisis Management Planning Council. Members of this council include a representative from the following areas on campus: Technical and Information Services, Dean of the College of Technology, Engineering and Management, Student Services, the Counseling Center, Human Resources, Physical Plant, Safety and Risk Management, Student Health Services, University Relations, Student Life Services, and Dunn County Emergency Management. In 2003 and again in March of 2004, a crisis recovery table top exercise was performed with members of the Dunn County Emergency Management office and the Wisconsin Emergency Management office. In addition, UW-Stout employees and the University Police frequently train with the local fire department, Menomonie police department and the emergency management office. A Dunn County representative sits on the University's planning council. Likewise, the campus is represented at the Dunn County Emergency Operations Center (University of Wisconsin-Stout, 2003).

The second phase, hazard identification and risk assessment, includes four stages that can help identify the degree of vulnerability UW-Stout faces. The four stages are 1) identify hazards, 2) profile hazard events, 3) inventory assets, and 4) estimate losses (FEMA, 2003 August). The FEMA state and local planning how-to-guide, provides information specifically for natural disasters (FEMA, 2001 p. 2-20). The resources that had been identified in phase one can provide valuable expertise in the completion of phase two.

The first step in hazard identification and risk assessment involves identifying hazards. The local emergency management office would be helpful in determining what hazards the Menomonie area faces. The UW-Stout library holds extensive archives regarding disasters that have affected the university as well as the community in the past. This area of Wisconsin has well-documented occurrences of tornadoes. A tornado hazard risk assessment can be done by looking at a Wind Zone Map. The geographical location of Menomonie on the United States Wind Zone Map (FEMA, 2001 p. 2-20) indicates that we are in Zone III. This means that historically, in the last 40 years, this area is capable of producing winds up to 200 miles per hour.

Profiling hazard events is the second stage of the hazard identification and risk assessment phase. This step addresses in specific terms the scope and extent of damage a tornado could cause to UW-Stout. This will determine the type of impact a tornado will have on UW-Stout and can help identify the university's vulnerable assets. Initially, a determination of building design wind speed limits is needed. The map created by the American Society of Civil Engineers (ASCE) shows that

Menomonie is located in Wind Design Speed Zone IV. (FEMA, 2001 p. 2-20). Thus, in order for the structures on the UW-Stout campus to withstand a tornado, the buildings must be able to withstand 250 mile-per-hour winds. Secondly, a campus base map should be created that shows as many features of the UW-Stout campus as possible. Minimally, it should depict classroom buildings, dormitories, communications and computer facilities, laboratories, offices, libraries, food service, historic and architecturally important structures, parking areas, and any other unique attributes of the campus. Additionally, the map should include essential services such as fire, police, emergency communications, emergency operations centers, medical facilities, and shelters as all would be needed in the event of any disaster. Locations of hazardous materials and biological agents should also be on the map as this is important information for local first responders. Lastly, the map should include critical campus infrastructures such as roads, water, power, communication, and wastewater lines (FEMA, 2003 August). With the assistance of the Engineering department at UW-Stout, this map can be placed on a geographic information system (GIS). GIS can be used to store mapping information and will be more useful as data is added to the map. GIS can graphically show potentially damaged areas and buildings, repair costs, and systems and functions that are at risk should a severe weather event occur (FEMA, 2003 August).

An inventory of assets is the third stage of the hazard identification and risk assessment phase. Where the campus base map was useful in determining where hazards can occur, the inventory of assets determines what could be affected in the event of a tornado on UW-Stout property. An inventory of this nature could become very labor intensive. Therefore, the asset inventory stage should be narrowed to assets that area of importance from a public safety, historical, economic, or environmental perspective. Furthermore, it should be determined if these particular assets have been built to withstand the design wind speed. The date of construction of buildings should be determined to ascertain if they were erected before state or local building codes went into effect and/or if buildings were built to code whose wind speed standards are below those indicated for the geographical location of UW-Stout (FEMA, 2001 p. 3-24). Each building should be described in the hazard areas, noting the size in square feet, type of construction, materials, age, occupancy, maintenance schedule, and replacement and content values. In addition, any capital investments (defined by UW-Stout as having minimum value of $5,000.00), such as equipment, should be noted. Buildings should be described according to use. For example, UW-Stout would be described has having buildings devoted to classroom instruction, administration, support, research laboratories, libraries and collections, housing and dining, athletics, theatre, parking, and police, fire and emergency services (FEMA, 2003 August). In a university setting, building occupancy should be characterized as when occupancy is at peak, or in the case of residence halls, be characterized as an estimated continuous occupancy (FEMA, 2003 August).The conditions and vulnerabilities of the electric, gas, water, sewer, as well as the communication systems on the UW-Stout campus should be considered as well as the vulnerabilities of all back-up systems. Administrative systems are critical to continued operations. Administrative functions at UW-Stout are deployed from one of four buildings. The newest, Millennium Hall, and the second youngest, Administrative Services, should have internal facilities that are capable of protecting these important functions. The other two buildings on campus that house administrative records are Bowman Hall and Harvey Hall. These two buildings are at least 75 years old if not older. This would be one area where a detailed risk assessment should be performed.

The final stage of the hazard identification and risk assessment phase is the development of loss estimates. There are no standard loss estimation models and tables for tornadoes, however, an important factor is the vulnerability of structures when they are subjected to wind loads that exceed their design or the chance that flying debris will penetrate the building. Overall, building damages can range from cosmetic to complete structural failure, depending on wind speed and location of the building with respect to the tornado path, which no one can predict. The only way that UW-Stout could estimate structure vulnerability from a tornado event would be based upon historical occurrences of damages sustained and the design wind speed previously determined (FEMA, 2001 p. 4-4). An estimate of building content losses can not be done based upon the amount of damage to the structures because, again, there are not any standard loss estimation models and tables for content damage from tornadoes. A calculation of losses to structure use and function due to a tornado is based upon how long particular functions will be interrupted. A stepwise model to estimate these losses can be utilized by:

1. Determine functional downtime, or the time (in days) that the function would be disrupted from a tornado.

2. Estimate the daily cost of the functional downtime.
3. Divide the average annual budget by 365 to determine the average daily operating budget or sales.
4. Multiply the average daily operating budget by the functional downtime to determine the cost of the loss of function for the period that the business conducted in a particular building was unable to operate due to a tornado.
5. Determine the displacement time in days that a function may need to operate from a temporary location due to a tornado.
6. Multiply the displacement cost (step 3) by the displacement time to determine the cost of the displacement from the regular place of business due to a tornado (FEMA, 2001 p. 4-4).

The loss estimation should also include the possibility of human loss due to a tornado. The prudent approach would be to determine if and where shelter areas are located in each building in order to provide the safest place for people in the event of a tornado. An assessment of shelter design wind speed and the ability to protect all persons on campus will greatly affect the estimated numbers of possible human loss during a tornado.

The consideration of loss estimates should also include an appropriate cost justification model specifically for disaster recovery planning. The Miora Generalized Cost Containment Model (GCC), created by Michael Miora of the ContingenZ Corporation, was developed expressly for this purpose (Miora, 2002). The GCC model estimates the total costs of down-time or outages as a function of time after an event regardless of the cause. Costs for each function that has experienced an outage are added into a total cost figure only after the maximum allowable down time in days as been surpassed. Losses are then categorized into either tangible and direct loss, a tangible and indirect loss, or an intangible loss. Each function is also placed into one of four categories. The first category lists those functions that have been identified as critical to the organization and that also directly effect institutional operations. There are usually few functions listed in this area. The second and third categories have a greater number of functions listed but are not viewed as highly critical to daily operations. The fourth category usually has a greater number of functions listed but contribute less to the immediate need in business resumption than do those listed in category one. However, category four is the largest contributor to loss due to the magnitude of functions listed. While the loss experienced in category one begins immediately after a disaster, the losses experienced in category four may not begin for weeks and are therefore not added to the GCC model until the maximum allowable down time has been exceeded. A cumulative loss summary would provide an overall view of the incurred losses expected in, for example, 45 days (Miora, 2002).

The University of Wisconsin-Stout has always prioritized the need for long-range planning in the process of defining the strategic choices that are possible. A risk assessment of the university serves to identify the hazards that the university could face as well as identifying potential losses from these events. By going through the process described in phase two, the university can benefit by the subsequent improvement of long-range planning efforts to include the principles of disaster mitigation (FEMA, 2003 August). This process has the potential for providing positive financial impact on the university if UW-Stout chooses to strive for a "Highly Protected Risk" status. Some insurance companies define this as a facility that has taken considerable measures to reduce potential risks. This can sometimes result in lower insurance rates (Modic, 1995). In a personal conversation on September 1, 2004 with Lisa Walter, Police Chief for UW-Stout, she stated that additional funding is available to state and local government for the implementation of the National Incident Management System (NIMS) in the form of grant monies. It is at this point where the planning committee can now begin securing support and developing the plan.

The resources identified in phase one and the assessments completed in phase two will help to organize the completion of phase three, developing the mitigation plan. In phase three, actions that have been identified and prioritized should be laid out in detail in order to determine their relevancy and expected outcomes. All stakeholders in this process should be consulted when writing the plan in order to assure that all sources of input have been utilized and that the plan allows UW-Stout to be fully eligible for pre-and post-disaster funding (FEMA, 2003 August).

In general, the steps in this phase include prioritizing focus areas, determining appropriate mitigation actions, prioritizing mitigation actions, preparing an implementation strategy, and assembling the plan. Prioritizing the focus areas involves the comparison of UW-Stout's mission with the results obtained from risk assessment of the identified hazards. This should be a systematic effort to reduce the potential threats to the instructional, research and public service goals and objectives (FEMA, 2003 August). Establishing clear goals and objectives provides a framework to begin prioritization of focus areas. Goals are general statements that provide the vision of what is to be accomplished. For example, UW-Stout's goal for a tornado disaster mitigation plan could be to: 1) minimize interruption to the instructional mission of the university and 2) protect valuable research conducted on university property. Objectives specifically define how to implement or attain the stated goals. For example, UW-Stout may choose to have as objectives: 1) inform university community about potential hazards and the appropriate loss reduction actions that can be taken and 2) protect all capital equipment (valued at $5,000.00 or more). Mitigation actions help to achieve the goals and objectives that have been set forth. For example, UW-Stout could: 1) sponsor a campus hazards section in the weekly Community News e-letter that all employees and students receive, 2) provide reinforced, windowless areas to house capital equipment and 3) develop a training session for department chairpersons on hazard mitigation (FEMA, 2003). Initially, a brainstorming session could be scheduled to consider a full range of appropriate mitigation actions. The ideas brought forth could be put into one of four broad categories of mitigation actions. They include: 1) Prevention-the identification of storm shelters on campus to prevent human injury, 2) Property Protection-building structural support and reinforcing outer window glass and frames, 3) Public Education and Awareness-could be a charge to the UW-Stout Optimal Health

Committee or UW-Stout Safety Committee to distribute severe weather/tornado hazard information via e-newsletter, and 4) Emergency Services-provide NOAA weather radios to all departments and resident hall floors to assure a proper warning system is in place (FEMA, 2003 August). Once the actions have been identified, prioritization can occur. A common means of prioritization is based upon benefit-cost analysis; projects are compared based upon cost (FEMA, 2003 August). Ideally, the criteria ranking system would include consideration of life safety, operational criticality, and other hazard-specific considerations. Emergency management professionals, such as the Local Emergency Planning Committee (LEPC), can be of assistance in determining the strategic importance of the identified mitigation actions. An implementation strategy should be prepared in order to determine appropriate funding sources, responsibility for project supervision, and estimated timelines for project completion. For example, a template could be formed that would simplify the strategy format: 1) list of actions that were prioritized earlier, 2) the goals and objectives addressed, 3) identify the departments or persons responsible, 4) estimate of projected expenses, 5) funding sources such as from the operating budget or state funding, and 6) start and end dates-is the implementation of the action long-term or short-term (FEMA, 2003 August). Once everything is in place the new severe weather/tornado emergency action plan can be assembled. The final phase encompasses the formal adoption of the plan and actually putting the plan into action.

The severe weather/tornado emergency action plan should be presented to the Chancellor for formal adoption. Afterwards, the plan should be submitted to the resources that had been identified in phase one. For example, the Wisconsin University System would have a great deal of influence in the determination of financial allocation, personnel, and student matters that could affect the implementation process (FEMA,2003 August). Additionally, the plan should be presented to the Provost, the Vice Chancellor, all administrative units on campus including all business affairs units, all public safety and risk management divisions and any student services divisions identified in phase one. These persons should be asked to adopt the plan as well as persons off campus who would be affected by a natural disaster occurring on UW-Stout properties. Examples of off-campus stakeholders include the Menomonie Local Emergency Planning Committee, the Menomonie Police and Fire departments, the Dunn County Sheriff's department, the office of the Mayor, and local private industries such as 3M, Phillips Plastics, Anderson Window and Cardinal Glass. Having the City of Menomonie industries formally recognize the revised severe weather/tornado emergency action plan may increase the likelihood that they may contribute donations of materials should they be needed in the mitigation process (FEMA, 2003 August).

An advisory committee, appointed by the UW-Stout Vice Chancellor, would have the responsibility of developing a strategy for implementing the plan and overseeing implementation. The final step in implementing the plan is to have a method in place that effectively monitors and evaluates the strengths and weaknesses of the revised severe weather/tornado emergency action plan.

The implementation of an improved emergency action plan for severe weather could be accomplished by utilizing the best practices that have been set forth. At a minimum, UW-Stout could begin by purchasing 20 to 50 NOAA weather radios and by providing tornado shelter signage to 20 to 50 areas identified as safe areas to seek shelter within selected building sites. A severe weather/tornado drill could be conducted on a small scale so that the university could identify potential areas of improvement. After several successful drills have been conducted, UW-Stout administrative personnel could determine when it would be appropriate, both financially and based upon student population, to expand the drill sites to include the entire university.

CHAPTER III: METHODOLOGY

The purpose of this study was to implement a comprehensive severe weather/tornado emergency action plan for the University of Wisconsin-Stout. The goals of this study sought to: 1) identify the best practices in the development of an emergency action plan, 2) evaluate various cost justification models for use in the implementation of an emergency action plan for severe weather and, 3) introduce a redesigned severe weather/tornado emergency action plan for implementation at the University of Wisconsin-Stout.

Subject Selection and Description

The University of Wisconsin-Stout was selected as the subject of this study. UW-Stout has approximately 1,200 employees and an enrollment of 8,000 students. There are 2,700 students who live on campus grounds. The campus covers a total of 115.5 acres and is comprised of 21 major academic and administrative buildings and 11 student service buildings.

Data Collection Procedures

A review of literature was conducted to provide the data needed in the development of a comprehensive severe weather/tornado emergency action plan. The identification of best practices in emergency action planning, historical weather events in the immediate area, the costs involved in the distribution of weather radios, and the costs associated with the identification of tornado shelter areas all provided the basis for the development of an improved severe weather emergency action plan for UW-Stout.

A review of two other universities in the UW system was conducted to determine if UW-Stout could benefit from their emergency action plans for severe weather and as a means of comparison to determine the strengths and weaknesses of the emergency action plans. The universities, UW-Stevens Point and UW-Milwaukee, were selected because they represent a geographical cross section of the state of Wisconsin and are under the financial direction of the UW System as a whole.

An evaluation of possible cost justification models for use in disaster planning was conducted to determine the most appropriate means to budget for the proposed severe weather policy improvement. This included a review of the recommendations from the Federal Emergency Management Agency in calculating loss estimates as well as the recommendations provided by a privately owned incident management company.

In order to implement an improvement to the current emergency action plan for severe weather, an initial request must be submitted to UW-Stout Safety and Worker's Compensation Committee. An outline of the new plan, the proposed means of implementation, and the costs involved should be included with the initial request so that the committee has the information they need to determine if they will support the improvement of the current plan. If the committee is in agreement to support the new plan, they will forward their request to the Vice Chancellor who will initiate the process of policy development.

Limitations of the Study

1. This study was limited to the particular geographical location of UW-Stout and the perceived risk and frequency of enduring a severe weather event based upon historical reports.
2. Time would be a factor in the actual implementation of the new plan due to unforeseen delays in attaining administrative approval.

CHAPTER IV: RESULTS

The purpose of this study was to implement a comprehensive severe weather/tornado emergency action plan for the University of Wisconsin-Stout. The campus emergency plan indicates that during a tornado emergency one should seek shelter and carry a radio with them. However, there are no weather radios readily available for university departmental use nor are there areas in each campus building that have been designated as a tornado shelter. A severe weather drill for the population on the UW-Stout campus has never been performed. In order to improve the current situation, the following goals were considered as a basis for this study: 1) identify best practices in the development of an emergency action plan, 2) evaluate various cost justification models for use in the implementation of the emergency action plan for severe weather and, 3) introduce a redesigned severe weather/tornado emergency action plan for implementation at the University of Wisconsin-Stout. To achieve the stated goals, the methodology in this study included a review of literature, an overview of the emergency action plans for severe weather from UW-Stevens Point, UW-Milwaukee and UW-Stout, an evaluation of possible cost justification models to use in disaster planning, and a review of the procedure that should be followed when proposing a change in the severe weather policy for the University of Wisconsin-Stout.

Identify Best Practices in the Development of an Emergency Action Plan

In order to identify best practices in the development of an emergency action plan, it was necessary to determine the regulatory requirements that a state-governed educational institution must follow when considering such a plan. The Wisconsin State

Statutes, Chapter 166, the Operations and Planning Guidance document, June 2003, provides direction to Wisconsin counties in planning for the continuity of operations should a natural or man made disaster occur. On October 30, 2000, President Clinton signed the Disaster Mitigation Act of 2000 into law. The purpose of this law is to provide funding incentives to states that have developed a comprehensive, enhanced mitigation plan prior to disaster. On September 8, 2004, the U.S. Department of Homeland Security distributed a letter to all state governors delineating the National Incident Management System (NIMS) requirements. As of fiscal year 2005, all states are to use the same standardized procedures in incident management when a homeland security incident occurs, whether it is as a result of terrorism or natural disaster.

The use of best practices in emergency action plan development creates an optimal situation because the overall goal becomes the protection of human life, the minimization of injury and the protection of property. The best practices in the creation of a comprehensive emergency action plan for severe weather incorporates a four-phased process for identifying and implementing actions to reduce or eliminate loss of life, property, and function due to natural hazards experienced by universities in the United States. The four phases can be summarized as follows:

1. Organize Resources
    a. Identify resources on campus as well as community stakeholders.
    b. Form an advisory committee with a selected campus leader.
2. Hazard Identification and Risk Assessment
    a. Identify hazards

b. Profile hazard events

c. Inventory UW-Stout assets

d. Estimate losses

3. Develop the Mitigation Plan

a. Prioritize focus areas

b. Determine appropriate mitigation actions

c. Prioritize mitigation actions

d. Prepare an implementation strategy

e. Assemble to plan

4. Adoption and Implementation

a. Adoption

b. Implementation

c. Monitoring and Evaluation

Evaluate Various Cost Justification Models for Disaster Planning

An evaluation of various cost justification models for use in disaster planning was conducted in order to provide a starting point in forecasting the costs that would be associated with the implementation of an improved emergency action plan for severe weather. A review of the Federal Emergency Management Agency's State and Local Mitigation Planning guide revealed that there are no standard loss estimation models for tornadoes. The most applicable means of loss estimation would be to determine the wind load that each building was designed to handle. Building damages can be difficult to predict because it is unknown whether or not the building will be in the path of the tornado and the actual wind speed occurring at any given place and time is difficult to ascertain. A calculation of losses to structure use and function due to a tornado can be based upon how long particular functions will be interrupted. FEMA suggested that a stepwise model be used to calculate an estimation of losses using time as a factor. The model utilizes six steps in the process.

1. Determine functional downtime, or the time (in days) that the function would be disrupted from a tornado.
2. Estimate the daily cost of the functional downtime.
3. Divide the average annual budget by 365 to determine the average daily operating budget or sales.
4. Multiply the average daily operating budget by the functional downtime to determine the cost of the loss of function for the period that the business conducted in a particular building was unable to operate due to a tornado.
5. Determine the displacement time in days that a function may need to operate from a temporary location due to a tornado.
6. Multiply the displacement cost (step 3) by the displacement time to determine the cost of the displacement from the regular place of business due to a tornado (FEMA, 2001 August p 4-4).

A privately owned incident management company, the ContingeZ Corporation, also concurs with FEMA's means of estimating loss or cost as a function of time. The Miora Generalized Cost Containment Model (GCC) was developed specifically for disaster management planning. The GCC model estimates the total costs of down time or outages as a function of time after an event regardless of the cause. The GCC model could conceivably be implemented after the calculations in the FEMA loss estimation model have been ascertained. At this point, the identified losses would be put into one of four categories based upon the criticality of the functional loss to the university. A cumulative loss summary would be created from this data to provide an overall view of the incurred losses expected in a given period of time.

Introduce a Redesigned Severe Weather/Tornado Emergency Action Plan

The final goal of this study was to introduce a redesigned severe weather/tornado emergency action plan for implementation at the University of Wisconsin-Stout. Initially, a plan or policy of this nature should be presented to the UW-Stout Safety and Worker's Compensation Committee for consideration. A personal conversation on December 2, 2004 with Dean Sankey, Director of Risk Management Services for UW-Stout revealed the steps that occur when the approval of a new or revised policy is requested. After the UW-Stout Safety and Worker's Compensation committee members have reviewed all aspects of the new proposal, the committee forwards their recommendation for approval or improvement to the Vice Chancellor. The Vice Chancellor reviews the content with the Chancellor. The Chancellor then distributes copies of the proposed policy to all of the campus committees who would be affected by the policy change. In this case, it would be all committees that encompass the entire campus. Each committee would provide their input for approval and revisions to the new policy. At this point, the policy with the additional suggestions is routed back to the Vice Chancellor. The Vice Chancellor reviews the updates and makes the changes that he/she approves and then presents the final document to the Chancellor, who provides final approval by signing off on the new policy. The document has now become an official policy of the UW-Stout campus.

CHAPTER V: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The University of Wisconsin-Stout campus regularly practices fire evacuation drills but has never conducted a planned drill to seek shelter in the event of severe weather such as during a tornado warning or watch. The campus emergency plan indicates that during a tornado emergency one should seek shelter and carry a radio with them. There are no clearly marked tornado shelters in any building on campus nor is there a procedure in place that allows the communication of impending severe weather to the building inhabitants. Considering the propensity for severe weather in this area of Wisconsin, an emergency action plan should be implemented to decrease the risk of injury to people and damage to property during a severe weather event. The purpose of this study was to implement a comprehensive severe weather/tornado emergency action plan for the University of Wisconsin-Stout. The goals of this study intended to accomplish the following:

- Identify best practices in the development of an emergency action plan.
- Evaluate various cost justification models for use in the improvement of the current emergency action plan for severe weather.
- Introduce a redesigned severe weather/tornado emergency action plan for implementation at the University of Wisconsin-Stout.

The methodology applied to this study included a review of literature, an overview of the emergency action plans for severe weather from UW-Stevens Point, UW-Milwaukee and UW-Stout, an evaluation of cost justification models to use in disaster planning, and a review of the procedure that should be followed when proposing a change in the severe weather policy for the University of Wisconsin-Stout.

In conclusion, it was determined that there are best practices, developed by the Federal Emergency Management Agency, for the implementation of an emergency action plan that can be successfully utilized by UW-Stout. The Miora Generalized Cost Containment Model can effectively estimate the dollar figure, expressed as a function of downtime, which UW-Stout stands to lose should a comprehensive severe weather/tornado emergency action plan not be implemented. The UW-Stout policy for new procedure implementation can be utilized in order to introduce the new severe weather/tornado emergency action plan to the university population.

Conclusions

- There is a disaster mitigation planning tool available from the Federal Emergency Management Agency (FEMA) that specifically targets the issues faced by universities in the United States. It is through the review of several FEMA documents that a four-phased process using best practices was developed in order to implement an improved emergency action plan for severe weather at UW-Stout. The four phases include: 1) Organize Resources. This is done by identifying resources on campus as well as community stakeholders. An advisory committee is then formed with a selected campus leader. 2) Hazard Identification and Risk Assessment. In this phase hazards are identified, hazard events are profiled, UW-Stout assets are inventoried, and losses are estimated. 3) Develop the Mitigation Plan. This third phase includes prioritizing focus areas, the determination of appropriate mitigation actions, the prioritization of those mitigation actions, the preparation of an implementation strategy, and the assembly of the plan. 4) Adoption and Implementation. This final phase also includes monitoring and evaluation for continuous improvement. An overview of this process could be presented with the approval of the UW-Stout Safety and Worker's Compensation committee to the Vice Chancellor for consideration. This four-phased process would put the planning phase in perspective in terms of who would be selected to serve on a UW-Stout steering committee to initiate and oversee this process. The steering committee could use the elements in this process for identifying and implementing actions to reduce or eliminate loss of life, property, and function due to natural hazards.

- Loss/cost estimation models were reviewed in order to provide the university administrative personnel justification for the improvement of the current emergency action plan for severe weather at UW-Stout. The best way to justify cost is to calculate losses to building structure and function due to a tornado based upon how long the identified functions will be interrupted. Loss/cost justification is a function of time. The Miora Generalized Cost Containment Model (GCC) can be utilized by UW-Stout in the determination of cumulative costs incurred due to a severe weather event. The criticality of the functional loss expressed as the number of days the function experienced down time will determine the number of dollars that could be saved if severe weather/tornado disaster mitigation plans were implemented on the UW-Stout campus. It is important to provide a model for cost justification when asking the UW-Stout Administration to spend money on the implementation of a severe weather/tornado emergency action plan. To make the case, it should be shown that the costs incurred in providing NOAA radios to all floors of all buildings, employing the manpower to identify appropriate tornado shelter areas, and reinforcing building structures as needed are justified by the fact that these actions could reduce the number of days that critical functions of the university have been halted due to a natural disaster such as a tornado.

- A request to the UW-Stout Safety and Worker's Compensation Committee can be made in order to initiate the process of implementing an improved severe weather/tornado emergency action plan at the University of Wisconsin-Stout. The committee will review the content of the proposal and either recommend or not recommend that further review be conducted by the Vice Chancellor. Although final approval can be a lengthy procedure, the process assures that all persons who will be affected by the plan have input. The persons involved will lend support in the implementation of the new emergency action plan for severe weather because they have helped to create the final product.

Recommendations

- The four-phased process identified as the best practice in the implementation of a severe weather/tornado emergency action plan should be initiated as soon as possible. The tasks to be accomplished initially should include the identification of shelter areas in each building and the proper signage installed to communicate where those areas could be located. An update to the Risk Management department website should identify each shelter location as well. Once these areas have been identified and communicated to the UW-Stout population, an actual tornado drill may be performed on campus, ideally, before the onset of the 2005 severe weather/tornado season in Wisconsin. During the drill, an evaluation should be conducted to identify any areas of improvement in the process. Once improvement has been made, a continuous evaluation and improvement cycle should occur with each drill performance.

- The Generalized Cost Containment Model for cost justification in natural disaster planning could be initiated by asking the UW-Stout Budget, Planning, and Analysis staff if they could assist in the identification of all critical functions of the university. A dollar value of lost revenue could be estimated for each day the function would be inoperable after the event of a tornado. This would provide the basis for the completion of the cost justification model.
- A proposal for the implementation of a severe weather/tornado emergency action plan should be presented to the Safety and Worker's Compensation Committee. The committee can develop criteria of the necessary skills needed in the determination of safe shelter areas and provide the Vice Chancellor with the costs associated with shelter identification, including signage. This should occur before the new fiscal year begins in June 2005. It would assure that the plan gets on the Vice Chancellor's annual list of items that must be addressed by the committee. A representative from each building should be determined by either volunteer basis or assignment basis as the main contact person in order to make sure that the

new plan is effectively communicated to all persons who live and/or work in each building.

Areas of Further Research

- A comprehensive plan to seek shelter in the event of severe weather could also be utilized as a component of UW-Stout's quest to improve the safety and security of the people and property that comprise the campus. Since the event of September 11, 2001, the UW-Stout Crisis Management Team is now in the early stages of implementing the National Incident Management System (NIMS). This would include the provision of adequate shelter for the campus population. If these shelter areas were readily identified through the implementation of the improved severe weather emergency action plan, the deployment of NIMS on campus would be expedited.
- An evaluation of all the buildings on campus should be made to determine the correct wind speed each structure is capable of withstanding. This would provide assistance with the determination of appropriate shelter areas.
- An invitation to the Directors of the UW-Milwaukee and UW-Stevens Point Environmental Health and Safety departments should be made to attend a session of the UW-Stout Safety and Worker's Compensation Committee to provide assistance in the review of the proposed emergency action plan for severe weather.

REFERENCES

Belville, J.D. (1987). The National Weather Service warning system. *Annals of Emergency Medicine, 16*(9), 1078-1080.

Bohonos, J.J. and Hogan, D.E. (1999). The medical impact of tornadoes in North America. *The Journal of Emergency Medicine, 17*(1), 67-73.

Bureau of Construction Codes-State of Michigan. (2002, July 29). *Fire and tornado drills (08-98) bulletin 2.* Retrieved July 30, 2004 from http://www.michigan.gov/cis/0,1607,7-154-10575_17573-46091--,00.html

Disaster mitigation act of 2000 fact sheet. (2003, February 25). Retrieved August 20, 2004, from http://www.sdcounty.ca.gov/oes/resources/hazardmit/DMA2KFactSheet.pdf

Edwards, R. (n.d.). Storm Predication Center. *Tornado preparedness tips for school administrators.* Retrieved June 10, 2004 from http://www.spc.noaa.gov/faq/tornado/school.html

Edwards, R. (n.d.). Storm Prediction Center. *The online tornado frequently asked questions.* Retrieved August 18, 2004 from http://www.spc.noaa.gov/faq/tornado/#Safety

Emergency Email and Wireless Network. (2001, January 31). Retrieved August 18, 2004 from http://www.emergencyemail.org/

Federal Emergency Management Agency. (2001). Tornado hazard profiles. *State and local mitigation planning how-to-guide* (p. 2-20).

Federal Emergency Management Agency. (2001). Tornado hazard assessment inventory. *State and local planning how-to-guide* (p. 3-24).

Federal Emergency Management Agency. (2001). Tornado loss estimation. *State and local planning how-to-guide* (pp. 4-4 – 4-27).

Federal Emergency Management Agency. (2003, February 11). *Top ten U.S. killer tornadoes.* Retrieved June 10, 2004 from http://www.fema.gov/hazards/tornadoes/presskit6.shtm

Federal Emergency Management Agency. (2003, March 5). *Emergency management guide for business and industry.* Retrieved August 23, 2004 from http://www.fema.gov/library/biz3.shtm

Federal Emergency Management Agency. (2003, June 10). *2002 disasters-a look back.* Retrieved June 24, 2004 from http://www.fema.gov/regions/v/newsletter/volume_5/qrtly_n01.htm

Federal Emergency Management Agency. (2003, August). *Building a disaster-resistant university.* Retrieved June 10, 2004 from http://www.fema.gov/pdf/fima/dru_report.pdf

Federal Emergency Management Agency. (2004, October 22). *Homeowner's worksheet:assessing your risk.* Retrieved December 3, 2004 from http://www.fema.gov/fima/tsfs13.sht

Golden, J.H. and Adams, C.R. (2000). The tornado problem: forecast, warning, and response. *Natural Hazards Review, 1*(2), 107-118.

Gustin, J.F. (2002). *Disaster and recovery planning: a guide for facility managers* (2nd ed.). (p. 176). Georgia: The Fairmont Press, Inc.

Lillibridge, S.R. (1997). Tornadoes. E.K. Noji (Eds.), *The public health consequences of disasters* (p. 228). New York: Oxford University Press.

Mileti, D.S. (1975). U.S. Department of Commerce National Technical Information Service. *Natural hazard warning systems in the United States: a research assessment.* (pp. 6-64). Boulder, Colorado: Colorado University Institute of Behavioral Science.

Miora, M. (2002, May 3). *White paper: using the generalized cost containment (gcc) model.* Retrieved November 30, 2004 from http://www.contingenz.com/GCC.pdf

Modic, L. (1995). Preparing for the worst. *Engineer's Digest, 23*(9), 42-50.

National Climatic Data Center. (2001). *Wisconsin tornado damage 1950 – 1999.* Retrieved June 14, 2004 from http://sciencepolicy.colorado.edu/sourcebook/tornado/wistor.html

National Climatic Data Center. (2001, September 12). *The fujita tornado scale.* Retrieved June 14, 2004 from http://www.ncdc.noaa.gov/oa/satellite/satelliteseye/educational/fujita.html

National Oceanic and Atmospheric Administration. (n.d.). *Straight line winds in severe storms.* Retrieved June 24, 2004 from http://www.crh.noaa.gov/mkx/awareness/taw06.txt

National Oceanic and Atmospheric Administration. (2001, June 23). *What you need to know about tornadoes*. Retrieved June 25, 2004 from http://www.crh.noaa.gov/mkx/flyers/flyertor.htm

National Oceanic and Atmospheric Administration (2004, September 21). *Storm prediction center monthly tornado statistics*. Retrieved September 22, 2004 from http://www.spc.noaa.gov/climo/torn/monthlytornstats.pdf

National Weather Service. (n.d.). *NOAA weather radio*. Retrieved August 11, 2004 from http://weather.gov/nwr/

National Weather Service. (2003, December 17). *Severe thunderstorms*. Retrieved June 10, 2004 from http://www.crh.noaa.gov/mkx/awareness/taw05.txt

National Weather Service. (2003, December 17). *Tornado statistics*. Retrieved June 10, 2004 from http://www.crh.noaa.gov/mkx/awareness/taw04.txt

Pielke, R.J. and Pielke, R.S. (2000). Series forward. *Storms*. New York. ISBN 0-415-17239-X.

Ramsdell, J.V. and Andrews, G.L. (1986). *Tornado climatology of the contiguous United States*. Prepared for U.S. Nuclear Regulatory Commission.

Ridge, T. (2004, September 8). *Letter to the Governors of the United States*. Retrieved September 11, 2004 from http://www.fema.gov/txt/nims/letter_to_governors_09082004.txt

Tornado Project Online. (1999). *Wisconsin tornadoes 1950-1995*. Retrieved June 10, 2004 from http://www.tornadoproject.com/

University of Wisconsin-Stout (2003, May). *Crisis recovery.* Retrieved October 22, 2004 from http://www.uwstout.edu/ur/np/2003/fea_crisis.html

Weir, E. (2000). Tornadoes and disaster management. *Journal of the Canadian Medical Association, 163*(6), 756. Retrieved May 27, 2004, from ProQuest database.

Wisconsin County Government. (2003, June). *Operations plan guidance.* Retrieved June 16, 2004 from http://www.uwex.edu/ces/depthead/pdf/wiopsguidance.pdf

Appendix A: UW-Stout's Emergency Action Plan for Severe Weather/Tornado

Severe Weather/Tornado

Severe Weather/Tornado Watch: A watch is an indication of where and when the probabilities are highest that severe weather or a tornado could occur. A watch is a statement that severe weather/tornado conditions are present and could occur. The National Weather Service will issue a watch bulletin to local authorities as will as to the local radio and TV stations.

Severe Weather/Tornado Warning: When a severe weather/tornado sighting occurs, the National Weather Service alerts all weather stations and local authorities, including UW-Stout campus police.

If severe weather or a tornado is approaching, the warning will be signaled by a continuous sounding of emergency sirens.

In case of severe weather:

When the emergency warning sirens sound, it is YOUR responsibility to get to shelter. Take a battery operated radio with you to listen for the "all clear" signal. The department of Security and Police

Services, if time permits, may telephone the Chancellor, Vice Chancellors, Residence Life Director, and Computing Center Director. These offices will in turn notify their subordinates. The campus police may also announce the warning via car loudspeakers. When the emergency sirens are sounded, all persons should immediately seek shelter in the nearest strong building. Go to the basement or interior walls of lower floors. Auditoriums, gymnasiums and similar large rooms with wide roofs should be avoided. Stay away from all windows and exterior doors.

Note: City of Menomonie emergency sirens are sounded at 10:00 a.m. on the first Monday of each month during the months of May through September.

Appendix B: UW-Stevens Point Emergency Action Plan for Severe Weather/Tornado

General Severe Weather Response

1. Stay away from windows and exterior doors during all severe weather.
2. Notification of an approaching dangerous storm will be made by:
    a. County sirens.
    b. The National Weather Service and Emergency Alert System via the broadcast media, weather radios, and email alerts (if equipped). Monitor, prepare, and remain aware if conditions are present for possible severe weather formation.
    c. Protective Services will announce via voice public address systems (in certain buildings) and by person in certain areas when possible.
3. Recipients of warnings must quickly relay warning information throughout their areas.

Tornado Warning Response

1. When tornado warning is issued, building occupants should take shelter in the lowest level interior room without window exposure-preferably in a basement.
2. See building floor plans on the EHS website at http://www.uwsp.edu/ehs/ under "Severe Weather" for specific shelter locations at UWSP.
3. Shield yourself as well as possible by seeking shelter under sturdy objects, duck and cover your head with your arms, or by other available means. If you are unable to get to the lowest area, go to an interior room or stairwell away

from windows and exterior doors. Avoid wide-span structures such as gyms, pools, or large classrooms.

4. If unable to flee to a safer area, get under a desk, heavy table, or other object that could shield you from flying debris.
5. Remain in shelter area until instructed to do otherwise.
6. Keep a flashlight and battery-operated weather or other radio to take to the shelter area.
7. If driving, park your car and seek shelter away from the car in a nearby ditch or ravine. Avoid areas with power lines, poles or signs. Never try to outrun a funnel cloud or tornado in a vehicle.
8. After a tornado, watch for secondary hazards and seek emergency assistance as needed.

Severe Thunderstorm Warning

1. Severe thunderstorm warning notifications will be made by National Weather Service, NOAA Weather Radios, and local broadcast media.
2. Notify affected individuals and discontinue exterior work that may place persons in danger of the immediate storm.
3. Seek interior shelter away from windows and exterior doors.
4. If conditions worsen, employees may be advised to relocate to the designated storm shelters (see Tornado Warning section).

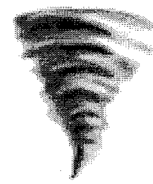
Appendix C: UW-Milwaukee Emergency Action Plan for Severe Weather/Tornado

UWM

Environmental Health, Safety & Risk Management

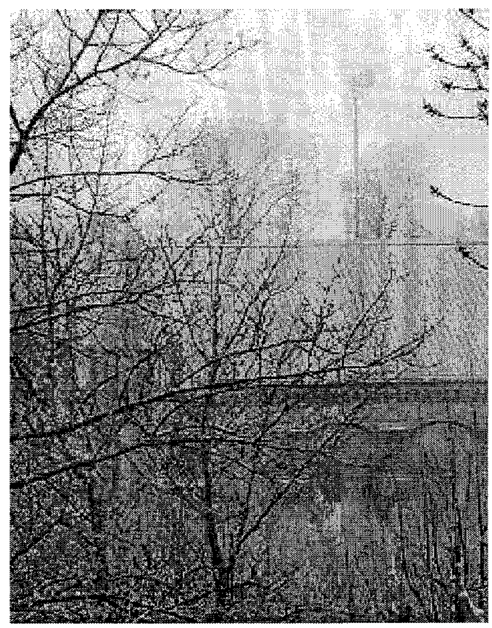
Tornado Safety

Quick Reference Link to *Quick Reference: Emergency Response to Tornado Warning* (.pdf document)



Click on link below to hear the audible tornado warning alert siren:

Tornado Warning Alert Siren



A "Tornado Warning" indicates a tornado has been sighted and you should immediately take shelter. The "Tornado Warning" signal is a steady blast three minutes or longer in duration. There is no "All Clear" signal.

There are 48 outdoor warning sirens located throughout Milwaukee County. The warning siren nearest to the UWM campus is located at 1311 E. Chambers Street. These sirens are only intended to be heard outside to alert people to take shelter indoors. A full sounding of the sirens is done at noon on the second Wednesday of each month (weather permitting).

How Big A Threat Are Tornadoes To UWM?

The UWM campus has never been struck by a tornado. However, twisters have been sighted near campus in years past. There is nothing about the UWM environment that would render it any more immune to tornadoes than any other piece of land in the Midwest. Contrary to popular belief, neither an urban environment nor the presence of Lake Michigan will do anything at all to deter or deflect a tornado. Tornadoes have been spotted in all areas of

Milwaukee County. The fact that no large loss of life has occurred here is due simply to good luck and random chance. Other urban areas in the Midwest have been struck by tornadoes, with heavy loss of life and property damage.

How Will I Know If Conditions Are Right For Tornado Formation?

The National Weather Service will notify the University Police and other area law enforcement agencies via teletype if a **"Tornado Watch"** is in effect. This condition means that weather conditions are favorable for the formation of a tornado, but that no tornadoes have yet been sighted. If you have a radio or television in you office, tune to local radio and TV stations and listen continuously for weather updates. Be alert to changing weather conditions and look and listen for signs of an approaching tornado. Signs such as blowing debris or a sound often described as a roar or a sound similar to an approaching freight train can mean a tornado is nearby.

How Will I Know If A Tornado Has Actually Been Sighted?

In the event of a "Tornado Warning", the National Weather Service will alert local agencies that a tornado has actually been sighted, either visually or by radar. Information will be transmitted over local radio and TV stations. A variety of notification methods will be used to direct all people on campus to seek shelter. Those University buildings which are equipped with voice public address systems will use them to notify occupants of any imminent danger, and to give directions on what to do. In addition, Milwaukee County Emergency Government will sound their warning sirens. **The tornado "Warning Signal" is a steady blast three minutes or longer in duration. There is no "All Clear" signal.**

What Should I Do If A Tornado Threatens The Campus?

First, stay put. Do not attempt to flee the tornado by foot or automobile. Twisters can move much faster than you can. Do not seek shelter in or under your car.

Secondly, move to a location inside the building away from windows or glass. Most injuries related to tornadoes are caused by flying broken glass or other debris. An interior stairwell, hallway, or room on the lowest floor or in the basement is best, as long as it is away from windows. Contrary to popular belief, the southwest corner of a building is no safer than any other corner of the building. You may want to consider moving to another building if necessary. The Union, Business, EMS parking structures would structure. Avoid auditoriums, gymnasiums, or other spaces with wide, free-span roofs.

How Long Do Tornadoes Last and How Fast Do They Move?

Detailed statistics about the time a tornado is on the ground or how quickly they move are not available. Their duration can range from an instant to several hours, but a typical tornado lasts approximately 5 minutes or so. Their movement can range from virtually stationary to more than 60 miles per hour. Typically, they move at roughly 10-20 miles per hour.

What is the Fujita Tornado Damage Scale?

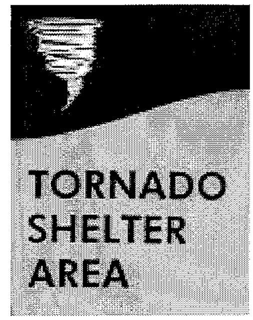
This Fujita Damage Scale (or F-Scale) is used to classify the strength of a tornado. The F-Scale gives tornadoes a numerical rating from F0 to F5. Because the F-Scale is based on tornado damage primarily to building, it can sometimes seem ambiguous. A tornado that moves over open country will tend to receive a lower rating than a tornado that strikes a populated area.

- **Category F0:** Light Damage (<73 mph); Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
- **Category F1:** Moderate Damage (73-112 mph); Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off road.
- **Category F2:** Considerable Damage (113-157 mph); Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
- **Category F3:** Severe Damage (158- 206 mph); Roofs and some walls torn off well-constructed houses, trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
- **Category F4:** Devastating Damage (207- 260 mph); Well-constructed houses leveled; structure with weak foundations blown off some distance; cars thrown and large missiles generated.
- **Category F5:** Incredible Damage (261- 318 mph); Strong frame houses lifted off foundations and swept away; automobile sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

IMPORTANT NOTE ABOUT F-SCALE WINDS: Do not use F-scale winds literally. These wind speed numbers are estimates and have never been scientifically verified. Different wind speeds may cause similar-looking damage from place to place—even from building to building. Without a thorough engineering analysis of tornado damage in any event, the actual wind speeds needed to cause that damage are unknown.

(Source for Fujita Tornado Damage Scale: National Oceanic & Atmospheric Administration)

Recommendations For Where to Seek Shelter in Campus Buildings:



(If for some reason you are unable to flee to a safer area, get under a desk, heavy table, or other object that could shield you from flying debris. Evacuation to a shelter or safer area is best, however.)

- **ALUMNI HOUSE**: Seek shelter in the basement.
- **ARCHITECTURE AND URBAN PLANNING (AUP)**: Seek shelter in basement hallways (e.g., carpentry shop), in auditoriums 110 and 170, or north stairwell of north tower. Avoid all rooms, hallways, and stairwells with exterior windows or display glass.
- **ART**: Seek shelter in stairwells or basement hallway. Avoid upper levels, rooms with skylights and exterior rooms/hallways with windows or display glass.
- **ARTS-LECTURE BUILDING**: Seek shelter in auditorium; avoid lobby area.
- **BOLTON**: Seek shelter in basement level or in the Business Administration Building's parking structure. Avoid all upper levels and exterior rooms.
- **BUSINESS**: Seek shelter in the parking structure or first floor interior lecture halls. Avoid all rooms, lobby areas, hallways and stairwells with exterior windows or display glass.
- **CHAPMAN**: Seek shelter in central hallway of first floor or in interior rooms and restrooms. Avoid upper levels, and all windows or exterior rooms.
- **CHEMISTRY**: Seek shelter in basement or lecture halls. Avoid all exterior rooms, laboratories, hallways, stairwells, and lobby areas with windows or display glass.
- **CUNNINGHAM**: Seek shelter in basement levels, floor 2, floor 3 or in stairwells. Avoid upper levels, exterior rooms or lobby areas with windows and areas near windows or display glass.
- **CURTIN**: Seek shelter in basement or stairwells. Avoid upper

levels, exterior rooms or lobby areas with windows, skylights or display glass.

- **ENDERIS**: Seek shelter in basement or stairwells. Avoid upper levels, exterior rooms or lobby areas with windows or display glass.
- **ENGINEERING and MATHEMATICAL SCIENCES (EMS)**: Seek shelter in basement, stairwells, or lower level of the parking structure. Avoid all exterior rooms or lobby areas with windows or display glass.
- **ENGELMANN**: Seek shelter in basement hallway; avoid rooms with exterior windows.
- **GARLAND**: Seek shelter in basement. Avoid all exterior rooms and upper levels.
- **GREENE**: Seek shelter in basement. Avoid all upper levels and exterior rooms.
- **HEFTER**: Seek shelter in the basement.
- **HOLTON**: Seek shelter in basement. Avoid all upper levels and exterior rooms.
- **JOHNSTON**: Seek shelter in basement. Avoid all upper levels and exterior rooms.
- **KENILWORTH**: Seek shelter in basement or windowless stairwells. Avoid areas with exterior windows.
- **KLOTSCHE CENTER**: Seek shelter in the lower level (e.g., racquetball courts) and away from the glass entrance doors. Avoid the arena and natatorium.
- **KUNKLE CENTER**: Seek shelter in the basement hallway. Avoid all exterior rooms and lobby areas.
- **LAPHAM SCIENCE CENTER**: Seek shelter in basement, or hallways and rooms with no exterior windows or display glass. Avoid all rooms, lobby areas, hallways, and stairwells with exterior windows or display glass.
- **LIBRARY**: Seek shelter in the interior spaces of the building away from exterior and interior windows, such as the microfilm room, compact shelving-west (basement), east basement shelving, or stairwells with no exterior glass. Avoid the first floor areas of the east and west wings, the glass enclosed stairwell and lobbies, overhead walkway between the two wings, and compact shelving-east study area.
- **MELLENCAMP**: Seek shelter in basement. Avoid upper levels, exterior rooms and stairways with windows.
- **MERRILL**: Seek shelter in basement. Avoid upper levels and exterior rooms.
- **MITCHELL**: Seek shelter in basement, away from windows. Avoid upper levels and exterior rooms.
- **MUSIC**: Seek shelter in basement.
- **NORRIS**: Staff to draw blinds in their offices or rooms to contain possible flying glass and debris. Seek shelter in basement hallway or

basement rooms without exterior windows: B-10, B-14, B-16, B-20 and B-24.

RN/MA should assist disabled occupants in moving to the basement shelter.

1. Mobility impaired-wheelchair-elevator to shelter
2. Mobility impaired, non-wheelchair-elevator to shelter
3. Hearing impaired, inform of announcement and shelter advice
4. Visually impaired, offer elbow and assist to shelter

- **PEARSE**: Seek shelter in basement. Avoid all exterior rooms and upper levels.
- **PHYSICS BUILDING**: Seek shelter in basement, or hallways away from windows. Avoid all, exterior rooms, ground floor lobby, and breezeway between Physics and Olson Planetarium.
- **PLANKINTON BUILDING**: Seek shelter in interior rooms/stairwells away from windows.
- **POWER PLANT:** Seek shelter in basement.
- **PURIN:** Seek shelter in basement or parking garage. Avoid windows and louvers.
- **SABIN**: Seek shelter in basement hallway or basement-level interior rooms. Avoid all exterior rooms and upper levels, and any area near windows or display glass.
- **SANDBURG RESIDENCE HALLS**: Seek shelter in the lounge areas of each house, or the interior stairwells of the towers. Avoid all exterior rooms, glass enclosed lobbies, *and* the parking structure.
- **THEATER**: Seek shelter in basement. Avoid lobby, rooms, and hallways with exterior glass or skylights.
- **UNION**: Seek shelter in the parking garage, the basement level, or the stairwells. Avoid the north enclosure (e.g., atrium/food court), Ballroom, Wisconsin Room, lobbies and any other area with windows, display glass or skylights.
- **VOGEL HALL**: Seek shelter in basement or hallways away from windows.
- **WATER INSTITUTE / GREAT LAKES RESEARCH FACILITY:** Seek shelter in auditorium area outside the main office. Keep bay doors closed during tornado emergency.
- **ZELAZO:** Seek shelter in basement hallway; avoid rooms with exterior windows or display glass.

Other Resources:

- National Weather Service Storm Prediction Center Information on

Tornadoes
NOAA

- "Tornadoes -- Nature's Most Violent Storms: A Preparedness Guide" published by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, the American Red Cross and the National Weather Service

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Link to *Funnel Facts*, or the Emergency Preparedness Index Page.

Updated April 21, 2004 by SAK

University of Wisconsin-Milwaukee
Department of Environmental Health, Safety and Risk Management