THE JULY 13, 2004 ROANOKE ILLINOIS TORNADO EVENT: THE WARNING RESPONSE PROCESS AT THE PARSONS COMPANY

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1. INTRODUCTION

A desirable human response to a severe weather warning, or potentially life threatening event, will not always be achieved due to any number of reasons. However, a "Warning Response Process" involving four factors - Planning, Practicing / Preparing, Monitoring and Acting (Dubberke, 2005; Miller, 2005) - can greatly reduce the impact of an event on affected individuals.

On July 13, 2004, an F4 tornado ripped through the Parsons' Manufacturing Plant in rural Woodford County, Illinois. Although the plant was virtually destroyed, no fatalities or injuries occurred among the 150 persons in the plant storm shelters at the time.

The scientific aspects of the July 13, 2004, Roanoke Tornado event, and the warning process within the National Weather Service have been the focus of other studies (Shimon et al, 2005; Barker et al, 2005; Merzlock, 2005). This paper will focus on the proactive safety plan that was instituted at the Parsons Company, and the implementation of that plan prior to the devastation caused by the F4 tornado. A review of the life-saving actions taken at the Parsons Company the afternoon of July 13, 2004, as well as an assessment of the four "Warning Response" factors with respect to this event will be made.

2. THE WARNING RESPONSE PROCESS

The manner in which people respond to official information, or warnings, has been studied by social scientists since the beginning of the "Cold War" in the 1950s (Univ. Of Oklahoma Research Center, 1953; Kilpatrick, 1957; Fritz, 1957; Fogelman, 1958). The Warning Decision Training Branch (WDTB) of the National Weather Service (NWS) began to formally emphasize the importance of the public response to weather warnings in workshops presented to operational NWS meteorologists (WDTB, 2001). The WDTB expanded forecaster training, with respect to the warning response process, with an "Instructional Component" entitled ***Societal Impacts and Public Perception, Lesson 1: The Warning Response Process*** (WDTB, 2004).

This NWS training was primarily based on the six processes of warning response outlined in an extensive report, which reviewed more than 200 studies of warning systems and response (Mileti and Sorenson, 1990). The sequence of warning response defined by Mileti and Sorenson include: Hearing, Understanding, Believing, Personalizing, Confirming, and Deciding and Responding. Several very recent NWS outreach sessions and workshops in Illinois and Iowa (Dubberke, 2005; Miller, 2005) have refined this sequence into four stages of warning response: Planning, Practicing/Preparing, Monitoring, and Acting. Each of these will be described in the following sections.

2.1 Planning

The first step in warning response is Planning. The response will be more successful if the people responding to the information have an effective plan in place. Prior to establishing a plan, Mileti and Sorenson illustrated that the perception of risk is a very important step. Some aspects of perceiving the risk include any prior experience with the threat (such as witnessing a tornado), the length of residency in a location, and the perceived proximity to climatologically favored regions for various natural disasters.

Having a substantial shelter, or evacuation route, is the next critical step in this process, after the risk is assessed. Communities, homeowners, businesses, schools, or any place where people gather need to achieve this important measure This must be followed by verbal or written communication of the plan to the occupants of the structure to complete the planning stage.

2.2 Practicing / Preparing

Having a detailed emergency action plan is not enough. Participants in the plan must practice sheltering, or evacuation procedures for the plan to succeed. Practicing can be achieved through physically going through the steps of the plan, mentally reviewing the measures that would be taken, or by verbally discussing the sequence of events that would take place. Drills and "table top" exercises are two popular examples of practicing a plan.

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Preparing for a disaster can also be accomplished through community education campaigns. Mileti and Sorenson demonstrated that people responding to the warning must understand the information that is presented. The educational background and demographics of the community play a major role in the public's understanding of a warning. A higher frequency of certain types of natural disasters will generally result in an increased understanding of the perceived threat and warning information, as opposed to locations where a climatologically rare event is encountered.

2.3 Monitoring

The first two steps of warning response usually take place prior to the onset of an event, typically on the order of months or years. The third step, monitoring, is the most critical because it occurs on the scale of hours or minutes. The people receiving the warning information must be monitoring some type of mass media device (e.g. television, weather radio, computer, pager, phone system, etc...) for the message to be received. Failing to follow this important step will greatly minimize the amount of time the public has to react to the threat.

The presentation and content of the warning information is also critical for the perceived threat to be understood in real time. The use of graphics, or non-technical, easy to understand instructions can benefit the monitoring process.

A factor that can not be controlled, however, is the time of the day that the warning is disseminated. The information is less likely to be heard by a majority of the intended population late at night, as opposed to the daylight hours. This can be overcome, to a degree, by having a plan that takes this into account (e.g. having a designated overnight "weather watcher" in the facility or home, or a tone alert weather radio).

The physical location of the recipients of the warning is another factor that must be taken into account during the monitoring stage. People indoors near mass media devices are more likely to hear the warning than those outdoors or in larger indoor facilities, such as factories, malls or arenas. Community and business preparedness plans can help minimize this factor by the use of outdoor warning sirens or internal alert systems that can relay the information to large populations at one time.

2.4 Acting

Agencies involved in warning dissemination would like to believe that everyone in the affected region has acted upon the information as soon as it is received. This, however, is not usually the case. Mileti and Sorenson stated that most of the time, the majority of the population will go through three additional steps: Believing, Confirming, and Deciding and Responding.

The first three steps of the warning process may be perfectly executed, but is the warning believed? The advent of expanded information available on the Internet and mobile communications devices have allowed the public to weigh several factors prior to believing the threat. These factors can range from perceived susceptibility, severity of the threat, and the belief that there will be a positive outcome if action is taken. The "cry wolf" syndrome is the most referenced case with respect to believability. However, recent limited studies have shown that a previous false alarm is not a common factor in the believability of a warning (NOAA, 2004).

More than any other time in our history, people receiving warnings have a need for a continuous flow of information to confirm the threat. Mileti and Sorenson state that this can be accomplished by the use of multiple mass media sources, communications with trusted individuals, or by personally observing and assessing the threat. The confirmation step helps recipients of the information better understand the warning, believe the warning, personalize the risk, and make response decisions.

The final step of the entire warning response process is making a decision, and responding to the decision that is made. Mileti and Sorenson infer that people will usually do what they believe will minimize their risk. Sometimes, however, this could be interpreted as irrational behavior by an observer, but it is perfectly rational in the mind of the person responding to the event.

3. THE SEVERE WEATHER SAFETY PLAN AT THE PARSONS COMPANY, INC - ROANOKE, IL

The Parsons Company, Incorporated is a medium-small sized business that does metal fabricating for makers of heavy earth-moving and material handling equipment. The company employs nearly 175 staff members at a main facility in rural Woodford county Illinois, approximately 30 kilometers (≈19 miles) east-northeast of Peoria, Illinois. The original manufacturing facility contained nearly 91,400 m^2 (≈230,000 ft^2) of space.

The owner of the company, Mr. Bob Parsons, witnessed a tornado near the present location of his facility, in 1974. The company he was working for at the time did not have a severe weather safety plan or shelters. When Mr. Parsons completed construction of his own facility in 1975, he designated the reinforced concrete block restroom as a storm shelter for his employees. The business continued to grow, and the manufacturing facility was doubled to more than 90,000 m^2. Additional reinforced concrete shelters were added and retrofitted, to bring the total of storm shelters to three. The company established a formal severe weather safety plan that was monitored by an Emergency Response Team (ERT) early in 2000.

3.1 Details of the Parsons Co. Severe Weather Plan

The Parsons Company Severe Weather Plan (Coulter and Eastman, 2004) relied upon the monitoring of NOAA Weather Radio – All Hazards (NWR) for Severe Thunderstorm Watches, Tornado Watches, Severe Thunderstorm Warnings, and Tornado Warnings issued for Woodford county, Illinois by the NWS Weather Forecast Office (WFO) in Lincoln, Illinois. Two individuals in the accounting department were assigned the task of monitoring the NWR. If a Severe Thunderstorm or

Tornado Warning was issued for Woodford county, the monitoring individual would notify the ERT Coordinator or plant Safety Manager of the information that was broadcast. The ERT would set up trained severe weather spotters outside the facility to assess the threat. If a severe thunderstorm was deemed to be imminent, or if a funnel cloud, or a tornado was spotted, the ERT Coordinator or plant Safety Manager would communicate with the monitoring individual, and tell them to make the following announcement on the company's public address system:

> **"Attention employees: The National Weather Service has issued a severe storm warning for our area. At this time, please we are asking that you move to the storm shelters nearest your location."**

This announcement was made three times. Production would be brought to a halt, and the employees would immediately go to their designated storm shelters, which were previously established by conducting drills (**Figure 1**). Shortly afterwards, the facility supervisors would go to the farthest location from the storm shelters and start "sweeping". Sweeping meant that the supervisors would comb the inside and outside of the facility, and verify that all employees, visitors, and contractors were present and accounted for in their designated shelters. Facility security dictated that every non-employee on the premises had a badge, with a manager knowing the location of the visitor. This made it easier to identify and account for visitors in the case of an emergency. Sweeping would be done until everyone was accounted for. After that time, the supervisors would then move to the closest shelters. The people in the shelters would not be permitted to leave until an "all clear" was announced by the ERT.

Biannual reviews of the plan were done by the ERT and an independent safety consultant, which was contracted by the Parsons Company. Biannual severe weather shelter drills were also conducted in Spring and early Autumn. These drills were assessed, with respect to communication and dissemination methods, and timed by the ERT and the safety consultant with a goal of having every employee in the shelters in less than four minutes.

4. THE WARNING RESPONSE AT THE PARSONS COMPANY ON JULY 13, 2004

4.1 Watch and Warning Messages Disseminated by the NWS

A Tornado Watch was issued by the Storm Prediction Center (SPC) for eastern Iowa, and northern and central Illinois - including Woodford county Illinois - from 1555 UTC 13 July 2004 until 2200 UTC 13 July 2004.

A Severe Thunderstorm Warning was issued by WFO Lincoln, IL for Woodford county at 1929 UTC (2:29 P.M. CDT) until 2030 UTC (3:30 P.M. CDT).

A Tornado Warning was issued by WFO Lincoln, IL for Woodford county at 1934 UTC (2:34 P.M. CDT) until 2015 UTC (3:15 P.M. CDT).

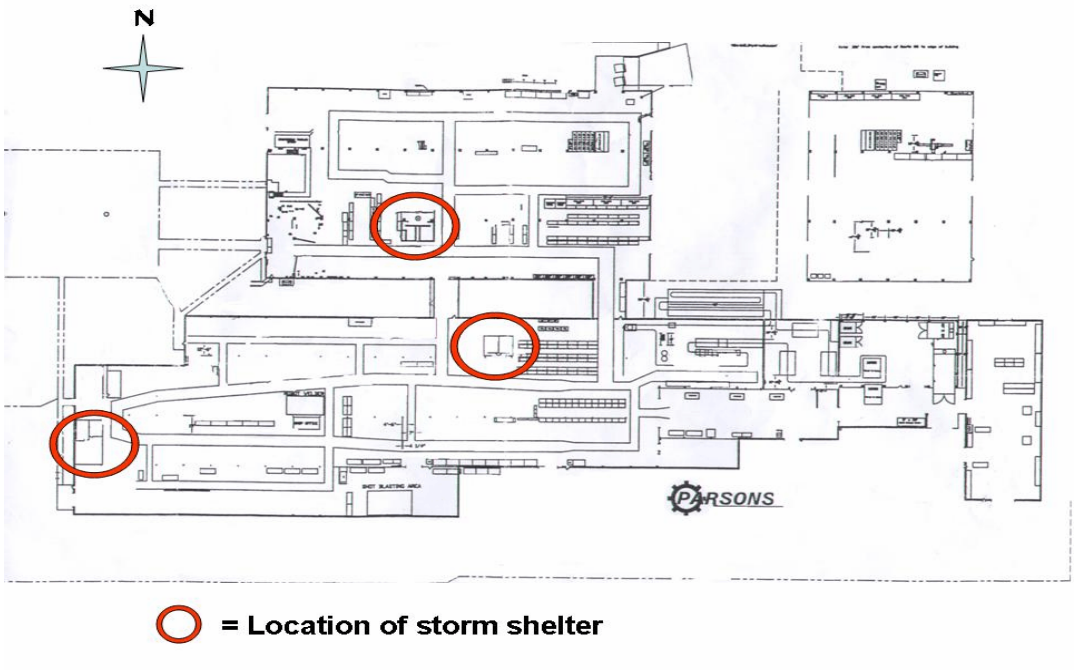

Figure 1. Schematic of the Parsons Company facility. Locations of the storm shelters are circled in red.

4.2 Actions taken at the Parsons Company

Accounting assistant Laura Marchand relayed information about the Tornado Watch to ERT Coordinator Dale Eastman at 1600 UTC (11:00 A.M. CDT). The sky was clear and there were no warnings in effect, so no additional actions were taken.

The weather radio in the Parsons accounting department sounded with a Severe Thunderstorm Warning for Woodford county, including the town of Roanoke, at 1929 UTC (2:29 P.M. CDT). Once again, Laura Marchand relayed information about the warning to ERT Coordinator Dale Eastman at 1930 UTC (2:30 P.M. CDT). Spotters were notified of the warning, and immediately noticed a rapidly growing thunderstorm with a rotating wall cloud, and then funnel cloud about two minutes later, approximately 8 KM (5 miles) west-northwest of the Parsons facility. Mr. Eastman contacted the accounting office and told them to make the severe weather announcement on the company's public address system. Accounting assistant Patricia Canon made the announcement at 1934 UTC (2:34 P.M. CDT) for the employees to begin moving to their designated storm shelters. At the time the announcement was being made, the weather radio alerted for a Tornado Warning for Woodford county. In addition, the tornado developed at that same time (1934 UTC), 6.5 KM (4 miles) west-northwest of the Parsons Company.

Parsons Company supervisors began sweeping the facility for the 140 employees and 10 visitors that were on site. The sweep was completed by 1937 UTC (2:37 P.M. CDT) - only 3 minutes after the announcement to seek shelter. Mr. Eastman made an additional check of the storm shelter in the south building and was told everyone was accounted for. He took another look outside at 1939 UTC (2:39 P.M. CDT) and saw the tornado about 1 KM (0.6 mile) to the west-northwest, before he headed into the shelter adjacent to the front office.

The tornado struck the Parsons Company at 1941 UTC (2:41 P.M. CDT) (**See Figure 2**). Damage surveys indicated that the central vortex of the tornado struck the north building, producing F4 damage on the Fujita scale (**See Figures 3 and 4**). Despite a direct strike by a violent tornado, there were no fatalities AND no injuries at the Parsons Company.

Parsons Safety Manager, Kevin Coulter, said "There is no doubt that the plan was executed except for the all clear. The employees just had to follow a supervisor out to safety on July 13....I still believe that it was Bob Parsons that saved these employees by building structures to duel as storm shelters and offices." (Coulter, 2005)

Figure 2. Photo of the F4 tornado as it was striking the Parsons Company at 1941UTC, 13 July 2004. Photo courtesy of Scott Smith.

Figure 3. Overhead picture of the damage at the Parsons Company, looking southeast. The yellow circles indicate the locations of the storm shelters. The center of the 0.4 KM wide tornado tracked through the building in the lower left of the picture. Photo courtesy of the Peoria Journal-Star.

Figure 4. Damage to the north building at the Parsons Company from the F4 tornado of 13 July 2004. The storm shelter is in the center of the picture, under the twisted I-beams. Photo by NWS.

5. ASSESSMENT OF THE WARNING RESPONSE PROCESS AT THE PARSONS COMPANY ON 13 JULY 2004

The fact that there were no fatalities AND no injuries to the 150 people present at the Parsons Company, during the violent tornado of 13 July 2004, can most likely be attributed to a successful warning response process at the facility. This section will assess each part of the warning response process to illustrate this event.

5.1 Planning at the Parsons Company

The prior experience of company owner Bob Parsons witnessing a tornado played a major role in this part of the process. As a result, Mr. Parsons made sure that his facility had adequate storm shelters, constructed of concrete and steel reinforced block walls, and thick, poured concrete ceilings. The company also established an Emergency Response Team, which drafted a severe weather plan, and contracted with an independent safety consultant to assess the plan.

5.2 Practicing / Preparing at the Parsons Company

The key to practicing was the biannual tornado drills which were conducted at the Parsons Company. Not only were the drills accomplished, but they were timed and evaluated. Each employee knew, through the process of drills, which shelter to go to, and how quickly they were expected to be there. During the drills, the supervisors practiced the "sweeping" technique, which was a critical part of the plan to account for all employees and visitors. Preparedness was accomplished by having weather spotters that were ready to recognize dangerous conditions and communicate it to the front office.

5.3 Monitoring at the Parsons Company

The main factor in monitoring was the use of a NWR receiver. The company's severe weather plan indicated which watches and warnings needed attention. Monitoring the information on the weather radio, and acting upon the Severe Thunderstorm Warning was very crucial in preventing injuries and saving many lives on 13 July 2004 at the Parsons Company.

Another component of the company's severe weather plan which played a major role was the use of a public address system within the two buildings of the facility. This system was able to quickly and effectively communicate emergency information to all 150 employees and visitors.

5.4 Acting at the Parsons Company

Actions at the Parsons Company were swift and decisive on 13 July 2004. Believability was not an issue in this event because of the company's severe weather plan, which dictated that confirmation be made as soon as the warning was received. The threat was quickly confirmed by the company's spotters, and relayed immediately to the accounting office for dissemination to the rest of the staff. There was no decision making to be made once the announcement to seek shelter was communicated on the company's internal public address system. All of the employees and visitors promptly moved to their designated shelters, without questioning the decision to stop production. This final step completed an extremely successful warning response process.

6. POSITIVE OUTCOMES OF THE WARNING RESPONSE AT THE PARSONS COMPANY

The actions taken by the Parsons Company did more than save lives at the facility. The success story spread across the United States in a short period of time, and will continue to be told for years to come. It has been, and will continue to be, impossible to quantify the direct influence of the warning response by the Parsons Company. Only a few of the many effects will be illustrated in this section.

6.1 Media coverage

The media began covering the effects of the violent tornado as it was occurring. Local newspapers had photographers covering the tornado as it was occurring, and were on the scene at the Parsons Company before all of the survivors had emerged from the shelters. Information that there were no injuries or fatalities was spread through local media outlets during the evening news. The following day, 14 July 2004, the story was being spread across the Midwest and the country by many of the television stations from Chicago, St. Louis, all of the network affiliates for ABC, CBS, NBC, CNN, FOX News, and The Weather Channel. An episode of The Weather Channel's Storm Stories, taped in late August of 2004, highlighted the tornado, and the actions taken at the Parsons Company (The Weather Channel, 2005). This extensive media coverage spread the success story of the warning response at Parsons across the United States.

6.2 NOAA / NWS projects

NOAA Public Affairs wanted to help publicize the positive outcome of the Parsons warning response to individuals and businesses across the country. Video crews arrived in early August to interview Bob Parsons, and other employees at the Parsons Company for a NOAA DVD. This DVD was distributed to each NWS office across the United States in the early Spring of 2005. These testimonials of the Parsons employees have been shared with thousands of people and business owners to educate them about the value of a successful warning response process.

The NWS WDTB also shared the lessons of the response at the Parsons Company as an instructional component in it's nationwide Advanced Warning Operations Course. The actions taken at Parsons were highlighted in the "Societal Impacts and Public Perception" core component as a lesson titled "The Warning Response Process". This training was viewed by every NWS forecaster between the late autumn of 2004 and the summer of 2005.

Several NWS offices in the United States conducted safety seminars for businesses in 2005. The primary theme was the importance of a disaster plan, illustrated by the success story at the Parsons Company as a model for warning response.

6.3 The "new" Parsons Company

Bob Parsons made the decision to rebuild his company within three days of the devastating tornado. Clean-up began immediately, with the north building completely cleared of debris within six weeks. A new 120,000 m^2 (≈300,000 ft^2) facility was designed, and construction began in late August of 2004. The shells of two new buildings were completed by late December 2004. The interiors of the buildings were finished by April, with a full production line operational shortly thereafter.

One of the cornerstones of the new Parsons facility was a design for five additional storm shelters. Two of the original storm shelters, which withstood the brunt of the violent tornado, remained in the new facility. The five new shelters were constructed of poured concrete, reinforced with 15.5 mm (5/8 inch) thick steel rods. The walls of the new shelters were built 0.25 m thick (≈10 inches), with concrete ceilings 0.45 m thick (≈18 inches). (**See figures 5 and 6.**) The Parsons Company will continue to utilize the original severe weather safety plan. Drills have already been conducted, and the plan has been reassessed to accommodate the additional shelters in the new facility.

Figure 5. The "new" Parsons facility - April 2005, looking southeast. Photo by NWS.

Figure 6. Two side-by-side, concrete and steel reinforced storm shelters in the new Parsons facility. Photo by NWS.

7. SUMMARY

Part of the mission statement of the NWS is "...to issue forecasts and warnings for the protection of life and property..." (NWS, 1999) . The issuance of warnings is only the beginning of the warning response process. This paper illustrated the findings of social scientists, with respect to the process individuals go through when planning for, or reacting to warnings. Four main components of the warning response process were identified and defined: Planning, Practicing/Preparing, Monitoring, and Acting. Neither of these can stand alone for a warning response process to be successful.

The success story at the Parsons Company illustrated how critical each of the parts of the warning response was. Had any portion of the warning response process been missing at the Parsons Company on 13 July 2004, the results would have been devastating to human life. We do not know the exact location of the next natural disaster, but it has been proven that having a disaster plan, and following that plan, can extremely minimize the risk for loss of life and property.

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