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Leading Community Risk Reduction

Evaluating the effectiveness of evacuation to protect people in the City of Solana Beach

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CERTIFICATION STATEMENT

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

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Abstract

The problem was identifying if evacuation is the most effective method to protect Solana Beach in the event of a large-scale emergency. Descriptive research was used with the intent of answering the research questions, how many people can emergency service personnel expect to move in a large-scale emergency? Is evacuation the most effective method to protect the community in a large-scale emergency? Are current Evacuation Plans comprehensive enough to facilitate evacuation in the event of a large-scale emergency? Data was obtained researching literature and conducting interviews to evaluate the effectiveness of evacuations to protect the community from the hazards most likely in the region and to identify the planning necessary to prepare for an evacuation.

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Introduction

The Southern California wildland fires of 2003 were a natural disaster that has had an effect on disaster preparedness and emergency service providers in the region. The Cedar, Paradise and Border Fires burned simultaneously in San Diego County in October, 2003 (Governor's Blue Ribbon Fire Commission [GBRFC], 2004). These fires resulted in the loss of sixteen lives and over 2500 structures and out buildings (McClintock and Parker, 2004). Because of recent natural disasters that have received a large amount of coverage from the media, the community has made evacuation planning the focus in many emergency planning efforts. The issue that needs to be acknowledged is that despite the need to move people in emergency situations, there is a danger associated with evacuating people and people have been injured or killed during evacuations. The research problem is evaluating if attempting to evacuate the population of Solana Beach is the most effective way to protect the community during a large-scale incident.

The Solana Beach Fire Department participated in the regional development of an evacuation plan that provides for the movement of people from impending harm. Because of the recent natural disasters that have damaged other parts of the country, the need for evacuation planning has become a priority for emergency planners in all parts of the country, including San Diego County. During the planning process, it needs to be identified how practical a large-scale evacuation could be and what would be required to achieve an effective evacuation of a city with a population of 12,979 (census) in San

Diego County. The research purpose is to evaluate the effectiveness of evacuation to protect the community in a large-scale disaster.

Descriptive research was used with the intent of answering the research questions: how many people can emergency service personnel expect to move in a large-scale emergency? Is evacuation the most effective method to protect the community in a large-scale emergency? Are current evacuation plans comprehensive enough to facilitate evacuation in the event of a large-scale emergency? Data was obtained using interviews of people who have participated in large-scale incidents requiring evacuations, reviewing case studies of other communities that have done evacuations and literature reviews to determine the effectiveness of evacuations for the City of Solana Beach.

Background and Significance

The City of Solana Beach is located in Southern California, a region that in the past has experienced earthquakes, coastal flooding, tsunami warnings and wildfires. Each hazard poses its own danger and the destructive potential of wildfires was illustrated during the southern California wildfires of 2003, where more than 2,500 structures and sixteen lives were lost in San Diego County alone. Following these wildfires there were a series of commissions and committees to research the actions taken during the emergency and present after action reports. The after action reports were intended to enhance emergency response and explore ways to improve the survivability of people involved in the wildfires. The literature review included a review of after action reports from different disasters that have taken place all around the country. These incidents vary in nature and range from hurricanes on the gulf coast to a fire in a metal processing plant in

Pennsylvania. The reports also have many common themes. One of the most common areas addressed in the after action reports is the need to evacuate the members of a community in times of disaster. The need for evacuation planning has been reinforced by the response to other large-scale disasters in the United States that have had advance warning and still seen large numbers of their population affected. The inference in all of the recommendations is that evacuation plans will inherently save lives during natural disasters. It is important to acknowledge that moving people in front of an oncoming disaster has risks and people died in Louisiana during evacuations for hurricane Ivan (USA Today, 2005), people died in Houston during hurricane Rita evacuations (CBS, 2005) and according to the interviews of Ott and Ghio (2007), all of the people that died in the wildfires of 2003 perished while in transit.

The stated role of any emergency responder is the preservation of life, property and the environment, in that order of importance. When the decision is made to evacuate an area, be it a home, a building, a block, or a city, the decision has been made to protect lives without any intention of preventing property damage or protecting the environment. This is the context by which to measure all evacuations. The incident that is occurring is too great for emergency responders to attempt to stop the forward progress of the hazard and all efforts are directed at preserving life.

An additional focus of evacuation planning directly relates to the National Fire Academy and protecting at-risk members of the community. The elderly, the young and people with special needs should be considered when preparing a city for an emergency. These members of the community may not be able to protect themselves from a disaster and it is the responsibility of the emergency responder to protect these people. It is a

portion of the community that requires more resources than the rest and advanced planning is needed to provide these needs. It is of significant importance to protect the lives of those that are not able to take care of themselves in a large-scale disaster.

The City of Solana Beach has a residential population of 12,979 (Census) that consists of eleven intersections that allow traffic into or out of the City. This has resulted in the question, is it practical or possible to move the entire population of Solana Beach during a large-scale disaster? This importance of this question is highlighted by the fact that interviews with personnel staffing EOCs and DOCs in San Diego County indicated that all of the civilians that died in the San Diego County fires of 2003 were in transit when the fire overtook them.

The focus of this paper will be to explore the possible effectiveness of evacuations and planning in San Diego County that are the result of the wildfires. Other issues will be addressed as well, such as how many people can emergency planners expect to move if the need to evacuate the community is present, the potential effectiveness of protecting people in place in the event of a large-scale disaster and whether evacuation plans that were developed as a result of the wildfires are comprehensive enough for the future.

Descriptive research was used to study other evacuations that have taken place in the past, interview personnel that were involved on the management level while evacuations took place and analysis of the effectiveness of the new draft evacuation plan in San Diego County. This paper will address the following questions; how many people can emergency service personnel expect to move in a large-scale emergency?; is evacuation the most effective method to protect the community in a large-scale

emergency?; and are current evacuation plans comprehensive enough to facilitate evacuation in the event of a large-scale emergency?

Literature Review

The literature review for this research was focused on gathering information about past evacuations. Case studies were examined to determine the effectiveness of other large-scale evacuations. These evacuations included examples of lessons learned from evacuations that didn't go well and success stories from evacuations that appeared to have prevented the loss of life from a disaster. Interviews of people who were assigned to management level positions during an EOC activation provided insight and analysis into the evacuation process from a management level. It was the intention of the literature review to examine past evacuations and assess the need and ability to evacuate people in Solana Beach during a large-scale incident.

A challenge that was identified during the research of this project was also identified in the United States Nuclear Regulatory Commission (USNRC) report. This challenge was that no specific evacuation databases were found during an intensive information review (U.S. Nuclear Regulatory Commission [USNRC], 2005).

Research indicated that many issues go into the effectiveness of an evacuation. Research conducted on multiple evacuations by the USNRC indicated that having an evacuation plan alone was not enough. Once a plan was in place, for an evacuation to be safe it needed to be tested and exercised. People interviewed during the USNRC investigation stated that they thought training and exercises had contributed to the effectiveness of their evacuations (USNRC, 2005).

As previously mentioned, just developing a plan is not enough to make an evacuation effective. Another aspect of an evacuation plan is community notification. Once the decision has been made to evacuate, the community needs to receive the information in a timely and accurate manner. If this method has been included in training and exercises in the past the potential for success is increased. The regression analyses conducted by the USNRC identified that community familiarity with alerting methods and door-to-door notifications were statistically significant for a more efficient evacuation (USNRC, 2005). This report was confirmed by interviews of Ott and Ghio.

In the USNRC report, approximately 2.4% of the incidents involved evacuations of more than 50,000 people, and 83.6% involved fewer than 10,000 people. This indicates that many more evacuations were conducted in cities the size of Solana Beach. The intent of the report was to determine factors that assisted in successful evacuations and identify issues raised in challenged evacuations. The study identified four factors that significantly affected the positive outcome of evacuations: (1) field-scale training and drills, (2) cooperation among government agencies, (3) use of an Emergency Operations Center (EOC), and (4) use of door-to-door notification and vehicle public address (PA) systems to alert the effected public (USNRC, 2005). The draft San Diego County evacuation plan will benefit by an evaluation using this criteria.

According to USNRC research, one of the lynchpins of a well coordinated evacuation effort is accurate public notification. Evacuation behavior at the Three Mile Island (TMI) Nuclear Power Plant in 1979 was studied in great depth by the USNRC. Their data suggest that the over-response at TMI was due, in part, to the confusing and conflicting information disseminated to the public, and they recommended providing the

public with accurate information and alternative protective actions to avoid over-response. Additional research conducted by the USNRC noted that over-response is also characteristic of hazardous materials evacuation. (USNRC, 2005).

It is important for emergency planners to acknowledge the importance of accurate information during community notification. The results of the Center for Survey Research & Analysis (CSRA) report highlights that confirmation-seeking was the primary initial activity that people pursued during an erroneous alert of the public in Connecticut in 2005. This confirmation seeking of information was typically pursued before following the instructions of the warning or even taking basic safety precautions (Center for Survey Research & Analysis [CSRA], 2005).

One of the important conclusions of the USNRC report was that people who receive information regarding a potential evacuation will attempt to verify the information received. In today's culture, one of the most common methods to verify information is the internet and this method should be used as a means of disseminating emergency information on available evacuation routes, congregate care center locations, traffic information, and precise areas requiring evacuation. One of the most common recommendations that was also included in the USNRC report was the reversing of traffic lanes (reverse-laning) along all major evacuation routes and increasing congregate care center capacity in many counties (USNRC, 2005).

The CSRA report of the Connecticut alert goes on to highlight the need for accurate information to the public. Connecticut residents who experienced the broadcast but were not very concerned by it, said the broadcast's lack of mention of a specific threat (58%) and lack of mention of a specifically threatened area other than the entire

state (49%), contributed to their lack of concern. Simply put, the broadcast seemed too general and nondescript to be taken seriously (Center for Survey Research & Analysis [CSRA], 2005). If emergency planners want the public to act in a certain manner, it is imperative that information is accurate and specific.

The information has to be more than accurate, it has to be confirmed. The lack of confirmation from other media sources was cited by about 4 in 10 (39%) as a "major" reason for their lack of concern (CSRA, 2005). The formation of a Joint Information Center (JIC) has been identified as a way to address this challenge in San Diego County.

The USNRC report made the distinction between the causes of evacuations. An issue was identified that evacuations resulting from natural disasters are often complex and involve multiple evacuations over several days and affect multiple communities. The report went on to identify the difficulties in determining the detail in complex evacuations and stated this detail was not practical in a report and often not possible to obtain. It is highly possible the number of evacuations due to natural disasters could be under represented in the database (USNRC, 2005).

In conducting research, the USNRC documented that the number of evacuations has been on the increase. This does not necessarily mean that the numbers of evacuations that have taken place are increasing, just that the reporting of the events has become more consistent. Events prior to 1997 were generally not as well documented, and therefore, more difficult to identify. Thus, the number of large-scale evacuations is not necessarily increasing over time (USNRC, 2005). The ability to track and analyze evacuations can be used to improve the ability to evacuate people in the future.

Because of the relatively small number of evacuations recorded, the statistics tend to reflect changes more dramatically. For example, the number of evacuations in 2002 was nearly double that of other years. The primary reason for the unusually high number of evacuations in 2002 was the high occurrence of wildfires. Using a more detailed reporting system over a longer period of time, the number of years that reported a large number of wildfires would probably be noted as a standard deviation as opposed to a doubling of evacuations over the other years (USNRC, 2005).

Distinct trends can be observed on evacuations as they relate to population centers. The evacuated communities were predominately suburban, accounting for 116 of the 230 evacuation incidents (or approximately 50%). Rural communities accounted for 77 evacuation incidents (34%) and urban communities accounted for only 37 incidents (16%) in the evacuation universe (USNRC, 2005). Solana Beach would best be described as a suburban city in San Diego County. The size of the evacuation also revealed trends. Large-scale evacuations were generally located near population centers, which is not surprising considering the main reason to evacuate people is to save lives. A large number of evacuations occurred in coastal areas which are prone to hurricanes and are typically industrial centers. This follows the repeating pattern of hurricanes providing advance warning in coastal property that is more densely populated (USNRC, 2005).

The type of incident resulting in an evacuation had a direct impact on the size of the area evacuated. Evacuations resulting from natural disasters, such as the Biscuit Fire near Cave Junction, Oregon that burned over 2000 square kilometers (50,000 acres), generally covered a much larger land area than those resulting from either technological hazards or malevolent acts (USNRC, 2005). Because of this information, the research for

this project focused on incidents that had a higher probability of occurring in Southern California. It is also important to note the potential effect an evacuation due to a wildfire would have in the suburban San Diego region.

Prior to the wildfires in Southern California in 2003, only six cases involved deaths from the hazard and of these six, only one case involved deaths during the evacuation itself. This occurred during the East Bay Hills Fire of 1991 when 19 people died while fleeing a wildfire in the steep hills near Berkley, California. The rapid fire progression, thick smoke, and very hilly terrain created the situation leading to these fire deaths (USNRC, 2005). This indicates that wildfires have resulted in a large proportion of evacuation deaths and other disasters have had safer track records in the moving of people.

The USNRC report observed that the decision to evacuate was made by a single individual in 40 (80%) of the cases while the remaining 10 (20%) cases involved two or more individuals in the decision making process. The fire chief was involved in the decision to evacuate in 25 (50%) of the cases while the police chief was involved in 11 (22%) of the cases. Only 6 (12%) of the cases encountered any issues in the decision making process (USNRC, 2005).

It is important to remember that all emergencies don’t result in the same type of evacuations. Evacuations resulting from natural disasters generally involve more time between the start of the hazard and the decision to evacuate and are often more unpredictable than evacuations resulting from technological hazards (hurricanes and wildfires are good examples of this unpredictability) (USNRC, 2005). This would

support the need for a timely, decisive decision to evacuate in order to keep people out of harm's way.

In order to maximize the potential for a successful evacuation, multiple methods of notification were the most common in reported cases, occurring in 35 (70%) of the cases. In 22 (44%) of the cases, people spontaneously evacuated before being told to do so (12 of these cases were natural disasters) (USNRC, 2005). When people receive little or unclear information, the potential for them to spontaneously evacuate before being told to do so, or refuse to evacuate, is raised. This results in the efficiency of the evacuation being adversely impacted and the potential for people being injured or killed.

There is a statistically significant association between hazard type (i.e., natural, technological and malevolent act) and the efficiency score recorded in the USNRC report (USNRC, 2005). This is an important aspect to take into account when developing an emergency plan in a region prone to natural disasters. There is a greater probability of encountering issues during evacuations due to natural disasters than during evacuations due to technological hazards. In natural disasters, the decision to evacuate generally takes longer than for evacuations due to either technological hazards or malevolent acts. (USNRC, 2005).This factor needs to be taken into account in every evacuation plan written in San Diego County.

In order to maximize the effectiveness of the evacuation in St. Charles Parish, top officials involved in evacuation indicated that persons beyond the one-mile radius were given somewhat more choice. It was reported persuasion rather than ordering was often employed in neighborhoods roughly within the two-mile radius; that is, households were warned of the danger and urged to leave. Those within the three-mile radius were told to

leave, but no great effort was made to persuade them to evacuate. They were told that if they chose to remain, they should stay indoors; if they were found outside, they would be arrested. The households within a four-mile radius were supposedly merely warned to leave (Quarantelli, 1983). This approach should be explored as a potential portion of an evacuation plan depending on the incident.

There is an increased probability of early evacuations occurring during natural disasters relative to malevolent acts and technological hazards, which is probably due to the significant advanced warning that evacuees are given for some natural disasters. The USNRC report shows that spontaneous early evacuation occurred in almost 85.7% of natural disaster evacuations, but in only 37% of technological hazard evacuations (USNRC, 2005). It is important to recognize that the majority of natural disasters studied in the USNRC report were hurricanes, which allowed for more advance warning than either wildfires or earthquakes. When this is taken into account the potential of early evacuation should be compared against the timeliness of the hazard information when dealing with spontaneous evacuations.

There is a significant relationship between the experience a community has had with a hazard and the evacuation preparedness. All 14 natural disaster evacuations were in communities that had prior experience with the hazard. Therefore, for natural disasters, it is not possible to assess the effects of community experience on evacuation success (USNRC, 2005). This statistic would be consistent with the Southern California experience with wildfires. It would be very difficult at this time to find a community that has not had a prior experience with wildfire.

The method by which the public is notified of an evacuation is as important as who does the notifying. When the public is notified door-to-door, there are fewer associated evacuation issues, and thus, a higher probability of evacuation efficiency (USNRC, 2005). This is a very time consuming method to notify the public and needs to be combined with other methods to be both effective and efficient.

According to the USNRC report, the larger the evacuated area, the more issues encountered during the evacuation. Natural disasters generally have the largest evacuation areas and thus, a greater number of issues associated with the evacuation (USNRC, 2005). This is the type of incident and geographic area that is most prevalent in San Diego County and emergency plans need to address the potential of the challenges associated with an evacuation.

While the USNRC report indicated that there are challenges inherent with spontaneous evacuees, it is also important to be aware that in major emergencies, people are extremely reluctant to abandon their homes and even businesses. They are more apt to evacuate when they can actually see the hazard; getting them to leave is very difficult when no smoke or flames are visible (American Fire Journal, 1995). This experience is consistent with the wildfires in San Diego County in 2003, resulting in all of the civilians that perished in the fire dying while in transit.

The decision to evacuate is made when the concern for life safety requires that all other mitigation efforts become secondary. In deciding whether to evacuate or protect in place, there are really only two basic decisions: if you decide to evacuate, how do you notify the public and how do you move them; if you protect in place, will they be safe, is there a way to notify them and how do you convince them to stay (Byran, 1995)?

In the research for their report, the USNRC identified that forty-seven (94%) of the cases analyzed involved communities that had a written emergency plan, and 40 (80%) had plans containing an evacuation section. In addition, 86% of the respondents said that the plans were used in the emergency. However, only 12% stated that their plans conformed to NUREG-0654/FEMA-REP-1 (criteria for preparation and evaluation of radiological emergency response plans and preparedness in support of nuclear power plants), and only one plan contained an evacuation time estimate (ETE) (USNRC, 2005).

It is important to continue to prepare for evacuation in Southern California because wildland/urban interface fires will continue to require evacuation. This wildland problem will only continue to grow based on residential development farther into the interface, the inherent hazards of development in a semi-arid region and undesirable construction technology such as wood siding, roofs, etc (Byran, 1995).

Research has consistently observed that most respondents will use a combination of sources for information on the fires from a variety of sources. In the Colorodo wildfires of 2002, over 75% of the people responding to the survey used more than one source for their information on the fire, primarily television, phone, newspaper and the Internet. Over 50% used three or more sources of information and slightly over 35% used four or more sources for their information (Benight, 2002). Evacuation planning should operate with the understanding that one of the first actions of people receiving the order to evacuate or stay in place will be to attempt to verify the information through another source.

The Benight survey also revealed other interesting trends. Survey participants with a longer time of residency believed that their property would be safer than newer

residents. Females also indicated significantly greater trust in governmental warnings/evacuations in relation to fire hazards (Benight, 2002). These items are interesting; however it would be difficult to account for these differences in an evacuation plan. This information would be more helpful on a case by case basis to a person ordering an evacuation.

A challenge in the Southern California region would mirror the findings from the Colorado wildfires of 2002. There was a general lack of preparedness on the part of the homeowners prior to the incident occurring. Very few of the respondents reported taking fire-proofing measures before the evacuation such as thinning trees, disposing of trash and debris to create a defensible space, changing roof types or clearing the gutter Benight, 2002). In Southern California there are codes that have been adopted that can assist emergency responders. It is up to the local jurisdiction to enforce these codes and they are only designed to increase defensible space and protect lives and property. It would be unrealistic to anticipate that the codes will result in fewer acres burned in a semi-arid region.

In the report on the Colorado wildfires, most people reported that previous experience with false alarms had little effect on their decision whether or not to evacuate this time, and earlier lessons learned may have even helped them in the evacuation process (Benight, 2002). Every emergency and call for evacuation will be evaluated based upon the information presented to the public. It is imperative that all evacuation plans include a public alerting system to provide accurate information.

Emergency responders and EOC managers need to weigh the benefits against the dangers of evacuation. A common misconception of evacuation is that it is without

danger. The Oakland-Berkeley Hills Tunnel Fire is a good example of the danger of trying to move people with the fire upon them. People didn't die in their homes. They died on the roads in a futile attempt to evacuate. Months earlier in Santa Barbara's Paint Fire, until then the most destructive fire in California, the only person killed by the fire was fleeing from her home. Her home survived, but she did not (Smalley, 1992).

Another example of the danger of moving people was during Hurricane Ivan in 2004. Four evacuees, a terminally ill cancer patient, two nursing home patients and a homebound patient, died after being taken from their storm threatened Louisiana homes for the grueling evacuation (USA Today, 2005). These people were in failing health and are more susceptible to the dangers of evacuation. This is an element of the population that needs to be considered when the decision is made to evacuate.

The article in Fire Chief Magazine highlighted the importance of public education. It recommended that on a parallel track with emergency planning, we should be retooling our public education and public information efforts. The focus of the message of these efforts should distinguish between interior and exterior fire threats. People should continue to immediately exit a building that has a fire in its interior that puts them at risk, but not automatically exit a building when there is an exterior fire threat. Instead they should evaluate the relative risks and listen to the direction of the experts (Smalley, 1992). The importance of public alerting was reinforced by the Governor's Blue Ribbon Fire Commission (GBRFC). The GBRFC recommended that local governments improve public outreach and emergency evacuation education (GBRFC, 2004). The education will help emergency managers create a predictable, organized behavior if the need to evacuate is presented.

The 2003 wildfires were a natural disaster that impacted a very large area. While the wildfires in California received most of the media attention, wildfires were also raging south of the border. In Mexico, firefighters were working to bring 30 wildfires under control that started that during the weekend. By the end of October all but two were under control, and hundreds of people evacuated near Ensenada had been allowed to return home. Two people died that Sunday when they were trapped in their burning home, one of about 15 Ensenada houses destroyed by the flames (USA Today, 2003). Early evacuation would have been appropriate and could have saved lives in this situation.

Evacuations were ultimately used and possibly effective in protecting lives during the wildfires. On Wednesday October 29, 2003, the Cedar Fire continued its extreme fire behavior, spotting over major roads and highways, with 200 foot flames and increased humidity to 80%. The communities of Julian, Pine Hills, Cuyamaca and Guatay were evacuated in addition to previously evacuated communities (GBRFC, 2004). At this time the fire had been burning for over four days and officials had time to plan and decide on a course of action. There were not any civilian deaths on the fires after this date.

The Oakland Hills fire of 1991 also presented unique challenges due to the extreme conditions. Many homes on the hill were wood frame construction and sited on western slopes. Because of the narrow roads, off-street parking was required, and garages and parking decks were situated above, if not on top of the homes themselves. As the firestorm progressed and these homes burned, structure collapse resulted in several cars rolling downhill and blocking the street below. In addition, many panic-stricken residents fleeing the area abandoned their cars when roads became blocked by other cars, smoke,

fire and neighbors fleeing on foot. With fire apparatus trying to get into the area and residents trying to get out, plus the attendant bystanders and the media, this historic fire resulted in the reexamination of disaster plans in many communities (Smalley, 1992). These conditions are not unique to Oakland and this incident is similar in many respects to wildfires that occurred before and after the Oakland Hills fire. These fires also present extreme conditions that should be addressed with any evacuation plan. The potential for poor or blocked access or egress is high. These challenges should be acknowledged and assumed in the planning stage.

While there was never an evacuation announced by the media in San Diego County many residents either were told to evacuate by deputies on scene or chose to evacuate spontaneously. As with the evacuation, residents returned to mountain communities on a community-by-community basis (GBRFC, 2004). This is consistent with past wildfires and the potential for this occurring in future wildfires is high.

There were also things that went right during the Southern California firestorm of 2003. The Mountain Area Safety Taskforce (MAST) in San Bernardino County was a huge success. As the fire threatened the San Bernardino County mountain communities, mandatory evacuation orders were issued to all residents. Despite the conditions and limited evacuation routes, over 80,000 residents evacuated their homes and businesses without serious incident. This task force is made up of state, local and county fire personnel and the community of Lake Arrowhead and presents a template for other communities to emulate. (GBRFC, 2004).

Extensive planning and public education took place in the San Bernardino Mountains because of the extreme fire danger in the area. Congressman Jerry Lewis,

along with other representatives, praised the evacuation of the San Bernardino Mountains and stated that “the efforts to fight the fire and evacuate residents out of the mountains were a model for efficiency and success” (GBRFC, 2004). The recurring theme of education and planning for a successful evacuation is highlighted by this report.

San Diego County was not as organized as the San Bernardino Mountains in its evacuation efforts. One of the major factors that led to confusion during the Southern California wildfire of 2003 was a lack of public information. It is important that the pubic, elected officials and the media have accurate, timely information (GBRFC, 2004). It is helpful for this information to be released through as many media outlets as possible, and as quickly as possible, to facilitate either an evacuation or a protection in place.

In addition to inaccurate information being released early in the San Diego fires, there was also a lack of information. This led to assumptions and confusion. An example was the public perception that if aircraft were not flying, fires were not being suppressed. Firefighting aircraft dropping water or fire retardant is the most visible fire suppression effort that the public sees. When these aerial resources are not flying, the public does not understand why these vital resources are not being utilized. It is important that the public be educated and understand the role and use of aircraft in firefighting operations (GBRFC, 2004). This information would be most useful if disseminated prior to an emergency and could be included in a public education campaign and reinforced at the time of the incident.

A message that has been repeated since the wildfires is that efforts need to be expanded on providing the public, elected officials and the media with accurate, timely fire incident and personal safety information. San Bernardino County’s establishment of a

Joint Information Center (JIC), CDF's use of a website for particular incidents, and the use of Public Information Officers at Emergency Operations Centers (EOCs) are just some of the ways that are currently used to attempt to accomplish this goal. At the same time, information must be provided to the public before an emergency occurs so that individuals can minimize their risk and support the actions recommended by the fire officials (GBRFC, 2004).

The GBRFC reported that many of the victims of the October 2003 wildfires indicated that they had no warning of the fire's approach. In examining potential early warning systems to address the needs of their communities, the commission recommended that local governments should consider reverse 911, emergency evacuation siren systems and potential combination systems, especially in remote areas (GBRFC, 2004). Early notification was the key and needs to include accurate information through as many media avenues as possible.

In their report, the GBRFC recognized the critical role of timely emergency notification of the public of imminent threats and recommends that local government prioritize the development of appropriate early warning systems to address the needs of their communities (GBRFC, 2004). The San Diego County Operational Area has identified the benefits of a community emergency notification system and has implemented the reverse 911 system as well as the 211 system for emergency public information. Additional upgrades will be explored as the technology is developed.

The importance of practice and planning is a recurring theme in multiple reports. In the Quarantelli, Hutchinson and Phillips report the importance of preplanning is highlighted. Although it was an evacuation due to a fire in Taft, Louisiana not a nuclear

incident, it was mentioned that the nuclear plant evacuation plan for the Waterford plant (one mile from Taft) was at least partly used in the evacuation (Quarantelli, 1983).

One of the important aspects when using the Quarantelli et al. (1983) case study is to identify the differences as well as the similarities. One of the major differences from Southern California is the governmental structure. St. Charles has the parish system of government typical of Louisiana. In fact, St. Charles Parish is not only the important administrative and operational government unit in the area, but the only formal one. None of the localities are incorporated, have elected officials, or have a budget (there are volunteer fire departments) (Quarantelli, 1983). This is in direct contrast to San Diego County which has eighteen incorporated cities, the unincorporated portion of the county and a multitude of special districts all working together in one operational area. To add to the contrast, all incorporated cities, and the County meet on a regular basis as the Unified Disaster Council (UDC) and conduct regional drills and exercises.

One of the similarities between Louisiana and Southern California is experience with natural disasters. There are some places in the United States which are subjected to high risks, but which have little actual disaster experience. This is not the case for St. Charles parish and the surrounding areas. They have experienced both natural and technological emergencies and disasters (Quarantelli, 1983). It is through these similarities that San Diego County can benefit from lessons learned about evacuations during disasters.

Although Hurricane Katrina has received a majority of the publicity over the last two years, New Orleans and the nearby river parishes have been impacted by many hurricanes. A Delaware Research Center (DRC) study in 1965 found that eleven major

hurricanes and 42 lesser windstorms had hit the coastal area since the turn of the century. In 1965, hurricane Betsy came right over the New Orleans metropolitan area, and created a major flood which forced massive evacuations in and around the city (Quarantelli, 1983). In Southern California and other disaster prone regions, it is not a matter of if, but when, a major incident will occur and how we react.

In disaster prone regions, the potential and occurrence of disasters results in large-scale emergencies becoming part of the fabric of the community. The term “disaster subculture” has been defined in disaster literature as a set of cultural defenses which are developed to cope with recurrent dangers, and includes “those adjustments, actual and potential, social, psychological and physical, which are used by residents of such areas to cope with disasters which have struck or which tradition indicates may strike in the future” (Quarantelli, 1983). These disasters subcultures are evident in many parts of the nation, and examples can readily be found in Southern California. It is important the emergency planners make education and preparation part of the mindset of the community.

The planning for a nuclear incident is an example of what good planning for all emergencies should encompass. This can be seen, for example, in terms of what happened when planning was initiated several years ago as a result of the nuclear plant construction. In conducting research, DRC was told by officials involved in drawing up the plan for radiological emergencies that they found the area seemed to have adequately prepared for other kinds of disasters (Quarantelli, 1983).The plan that was developed for a nuclear incident served the community well during a large chemical incident.

While it is important to develop an emergency plan, it is not the presence of written plans which stand out as the end product of evacuation planning. Such documents do exist, but it is all the different aspects of disaster planning which is more notable. Much thinking, many meetings, numerous contacts, frequent exercises - these and other crucial aspects of a planning process are notable in the approach to disasters in St. Charles Parish and should be modeled for all emergency planning (Quarantelli, 1983). The focus should be on planning rather than just producing a plan.

The personnel in the St. Charles Parish EOC were concerned because they feared that the situation due to the hurricane would worsen. The challenge was that personnel in the EOC were unable to take any concrete steps because of the lack of substantive information about what was going on and whether there were any future dangers for the community (Quarantelli, 1983). This comment was echoed by Ghio and Steffen in their interviews. A lack of accurate, timely information was a challenge in the decision making process in both the Paradise and Cedar Fires.

Time estimates to move people have been difficult to locate during research for this project. It is also unclear as to the reliability of these estimates. It is interesting that the Louisiana Power and Light Company in February 1982 released a revised evacuation estimate for a 10-mile radius from the Waterford nuclear power plant. The estimated time to evacuate this 10-mile radius was 5.25 hours in clear weather conditions, and 7.5 hours in adverse weather. While the situation for the modeling was different from the real incident, the actual evacuation (of roughly a 5-mile radius) was accomplished in about two hours in adverse weather, as well as darkness (Quarantelli, 1983).

Emergency planners should be optimistic about the potential positive impact of public education efforts. Despite the lack of response to the emergency broadcast, the vast majority of all Connecticut residents (77%) said that the erroneous February 1st alert had no real effect on their faith in the Emergency Broadcast System (Center for Survey Research & Analysis [CSRA], 2005). The implication is that if an evacuation is well coordinated in the future, it can have the effect of protecting members of a community.

An important aspect of community notification is that the impact of the message changes with who delivers it. According to the CSRA report, Connecticut residents would be most likely to believe the Governor or some other high level state official (74%), or local police or fire department (74%). There was a second tier of credibility as well: About 6 in 10 residents would believe an automated broadcast message which provides specifics on the emergency (58%), local officials such as a town mayor (57%) or national news reporter (50%) as sources in the event of a serious emergency. (CSRA, 2005).

There is a strong sense of one's home as the best refuge during an emergency. Most Connecticut residents (75%) would stay in their homes until they had no choice but to evacuate (CSRA, 2005). This fact was reinforced by the interviews of Ott and Ghio, each of which noted that all the people that died in the wildfires of 2003 were in transit. This is the pattern that has repeated in wildfire situations. People stay in their homes until the fire is almost upon them and then decide it is time to get out. This is where they are trapped and overrun by the fire, sometimes with fatal results.

The general impulse during the Connecticut false activation of the emergency alert system was for residents to confirm the situation, rather than immediately react to it.

Confirmation centered on checking the media, looking outside the home or calling others (calling friends and neighbors more than calling the authorities) (CSRA, 2005). It is imperative that any message intended for the public be transmitted via as many media channels as possible and be accurate and timely.

Of the Connecticut residents who responded to the CSRA survey, 39% turned to other television or radio stations to get more information; 29% looked outside to see if anything could be seen; 14% called a neighbor or someone else close by; 14% called a friend or relative who did not live close by; 13% checked their home supplies to see if they has enough essentials, such as food and water; 10% looked on the internet for more information; 6% called local police, firefighters or other emergency personnel; 4% headed to a basement or safe area in the home; 2% called local political offices – such as the mayor's office or town hall; 1% evacuated their home and attempted to drive out of state (CSRA, 2005). These statistics are representative of the reactions of a community and they can be helpful if they are used to assist in the effectiveness during an announcement of future evacuations.

Because of the incident in Connecticut being a false alarm, no specifics were included in the notification. The result was clear in the actions of those notified. Connecticut residents mostly blamed the broadcast's lack of a specific threat (58%) and its failure to identify a specific area other than the entire state (49%) as the major reasons why they were not very concerned about it (CSRA, 2005). If the information isn't specific and timely, it isn't going to have an impact on the community and the result will be confusion.

The respondents to the survey made their message clear. If, in the future they saw or heard an emergency broadcast message instructing them to evacuate the area, nearly all Connecticut residents (90%) say they would be very or somewhat likely to switch to some form of news media – either radio, TV or Internet – to try to confirm the emergency (CSRA, 2005). About 8 in 10 residents (77%) say they would be very tosomewhat likely to call a friend, neighbor or relative to confirm the emergency and about 7 in 10 (69%) would be very to somewhat likely to call local emergency personnel. Just over half (54%) of residents would be very (27%) or somewhat likely (27%) to stay at home and wait it out for as long as they could (CSRA, 2005).

It is interesting to note that the false alarm would not keep some residents from evacuating if told to do so in the future. Connecticut residents, however, are evenly split over whether or not they should evacuate immediately if they saw or heard an emergency broadcast in the future. Half of residents say they would be very (21%) to somewhat likely (27%) to evacuate while the other half would not be too (22%) or not at all likely (27%) to evacuate (CSRA, 2005). The fact that the person delivering the message would influence the decision making process was repeated in this survey. Nearly 7 in 10 Connecticut residents would be very likely to evacuate the area immediately if they were told to do so by the Governor or some other high level state official (69%) or a local policeman or fireman (67%) (CSRA, 2005).

It is useful to note that in addition to the person informing the public making a difference, the person being informed also makes a difference. Results indicate that women are more likely to evacuate than men (Radwan, 2005).

In Ghio's interview he stressed the importance of attempting to educate the public on an ongoing basis. The public will forget about the urgency of the situation with amazing speed. In 1993, Oakland established an assessment district, charging hills property owners a yearly tax for fire suppression programs. These funds were used to staff fire units and provide code compliance in the wildland urban interface. Four years later, that tax was voted down (Lockeo, 2001).

As noted in the San Diego County evacuation plan, the responsibility for evacuation during disasters (especially wildfires) belongs to the San Diego County Sheriff's Department (SDCSD). The first units responding to a wildland fire shall locate the fire incident commander and establish a liaison with him or his designee. This deputy communicates by radio to the sheriff's units which roads and communities need to be evacuated. As ranking personnel arrive, they should replace the incident commander liaison deputy. The department liaison should be a person who can make decisions and represent to the fire incident commander the sheriff's department's capabilities (McClintock and Parker, 2004).This is a very accurate description of what took place on the ground according to interviews conducted. By the time the EOC staff decided an evacuation was needed, people in the field had already begun the process.

Another aspect of the training bulletins developed by the San Diego County Sheriff's Department was the need for accurate intelligence. The bulletins noted the potential benefits of self-dispatching scouts to examine where the fire is going and what areas need to be evacuated. Extreme caution would be exercised in performing this function due to the possibility of becoming trapped on roads with no exits. The bulletin

suggested the use of the SDCSD Off Road Enforcement Team and/or ASTREA (helicopter) if possible (McClintock and Parker, 2004).

One of the lessons learned during the Paradise fire was the need to minimize radio traffic. Many deputies documented evacuation advisory refusals by putting the information on the air so that it became recorded for liability purposes (McClintock and Parker, 2004). Because of the resulting traffic on the airwaves, this practice was later discouraged and alternatives explored.

Another way to minimize radio traffic was to de-prioritize horse evacuation traffic. Seven percent of the radio traffic in the first hours of the Cedar Fire involved horses or horse trailers. Until another procedure is developed, deputies have been trained to attempt to save horse related traffic for times when the radio is not busy with human-related evacuation traffic (McClintock and Parker, 2004). The emphasis of emergency responders on animal rescue in the incipient stage of this emergency is an example of the confusion that can be created if the professionals don't provide accurate, consistent information.

Research did not locate any models to estimate the quantity of people that could be moved in an evacuation. It was also found that other micro-simulation traffic models are designed to simulate current conditions on existing roads and they have no capabilities to estimate network clearance time under emergency conditions (Radwan, 2005).

Research by the University of Central Florida (Radwan, 2005) confirmed what anecdotal experience had indicated. Three major findings revealed that traffic problems are becoming a major consideration in whether people evacuate. How they evacuate is

emerging as an issue for evacuation in whether people evacuate and an issue for evacuation traffic planning. First, about 25% took two or more cars. Nearly 50% left in one 6-hour period. Second, while the majority of respondents carried road maps, only 51% of those used them to determine their route (Radwan, 2005).

The Radwan study indicated that many evacuation planning tools were being studied in Florida as well as California. One of these tools is the policy of turning roads and highways into one-way thoroughfares. This policy is not without concerns, however; traffic management is a key issue, both in the implementation and enforcement (Radwan, 2005). The Radwan study and interview of Ott indicated that this policy could be dangerous and required extensive staff support in the field and coordination from emergency managers.

Research indicates that local media needs to be involved in informing the public about incident information. Experience indicates that this is a reasonable goal. When the Cedar Fire began on October 25, 2003, San Diego TV and radio stations carried crawler messages and break-ins. By the next morning, all San Diego news stations curtailed most of their regular programming and featured reporters interviewing firefighters and victims in an effort to keep viewers and listeners abreast of the unfolding events (NOAA, 2004). The goal of the emergency planner needs to be to use the media to carry the message that emergency response agencies want to relay. Experience had indicated that the alternative will be for the media to use information that may or may not be accurate or helpful.

In the report on the East Bay Fire (2003), an observation was made that most fire codes would have required an area with the fire risk characteristics of the Oakland Hills area to be evacuated. The comparison was made to a neighborhood with spilled gasoline

flowing in the gutters. This type of exceptionally tight regulatory control has never been applied in an interface area in the same way it is routinely applied to structures. The outcome of the Oakland Hills Fire appears to demonstrate the validity of the concept and also serves as an indicator of the fire potential in Solana Beach.

The Oakland Hills Fire demonstrated that it is extremely difficult to evacuate a heavily populated interface zone, particularly when the homes are enveloped in rapid burning and easily ignitable fuels. When wind, terrain, narrow roads, steep grades and other factors combine to accelerate fire spread and restrict passage, the risk to residents can be extreme. According to the report on the East Bay Fire (2003) and interviews with Ott and Ghio, once a fire starts spreading through the area, it may be too late to evacuate. This has been demonstrated in the Oakland Hills, Cedar and Paradise Fires. All decisions regarding evacuation or protecting people in place need to be made with the understanding of the risk of moving people or leaving them in harm's way in the face on a moving natural disaster.

The need for evacuations in the San Diego wildfires was the result of the worst fire situation in county history. Three major fires erupted burning a total of 383,269 acres; 2,453 homes were destroyed, 22 commercial properties and 763 outbuildings were destroyed. Sixteen lives were lost including one firefighter (McClintock and Parker, 2004), although the exact death toll will never be known because of the large amount of undocumented immigrants that were traveling through or living in the area.

Public notification should involve the advantages of technology but should also relay information in multiple forms. In Nanticoke, the community alerting system was an old but reliable method. Volunteers went door-to-door telling residents to evacuate and

woke people to the sound of the sirens and the calls to leave. Most thought something had happened at the nuclear plant because drills in the past had focused on evacuating for radiological emergencies. Consequently many citizens were familiar with the alert process (Stambaugh, 1987). The familiarity of the residents with the evacuation plan and pre-incident training coupled with accurate information resulted in a more effective operation.

It is necessary to plan, but every incident demonstrates the need to improvise. Choosing the school in Hanover as a host site for evacuees was a departure from the evacuation plan in place for a nuclear disaster – and is an example of how all hazard evacuations can vary from those specific to radiological emergencies (Stambaugh, 1987). A well written plan can provide an excellent framework but should not be considered to be unchangeable. Training and exercises will assist the decision makers with the ability to modify a plan on the fly and will enable the community to react in a predictable manner.

Although they are an important part of any emergency plan, shelters may not be used extensively in evacuations. In Nanticoke and the surrounding communities, only about 2,000 of the 15,000 evacuees sought refuge in Mass Care Centers. The remainder either had other homes where they could go or were patients at the nursing homes or the hospital and were evacuated by ambulance or bus to nearby medical centers (Stambaugh, 1987). Because of the demographics and income levels in coastal San Diego County, it is a realistic assumption that most people in Solana Beach would not utilize an evacuation center. However, in order to be prepared for worst case scenarios, emergency plans should be written and exercises conducted under the assumption that most people will go to the evacuation centers.

Although the emergency planners in Nanticoke focused on preparing for a nuclear incident, it proved the value of pre-planning and emergency preparedness. Credit for the safe and orderly evacuation of 15,000 people during the Spencer Fire in 1987 rested largely with four key factors: pre-fire planning for an adequate response; coordination of local and county emergency plans to streamline emergency response; practice to make perfect; the final lesson learned was secondary but important from an emergency preparedness standpoint. There is a silver lining to having a nuclear power plant as a neighbor (Stambaugh, 1987).This could also be a benefit of the planning as a result of the wildfires of 2003 in Southern California. Emergency preparedness for all incidents has improved.

In all evacuations, the first objective is always life safety. The primary problem faced was the evacuation of civilians over narrow streets while attempting to move fire apparatus into defensive positions (Winston, 1993). This was the case in the Oakland Hills, Cedar and Paradise Fires and will be the case in more wildland fires in Southern California. Evacuation needs to be planned and practiced to protect lives in a large-scale incident.

Procedures

Research began at the Solana Beach branch of the San Diego County library starting in August of 2006 where books on evacuation planning were requested from all county library branches. Research did not locate any books on the subject of evacuations and the next attempt was the Learning Resource Center (LRC) at the National Fire Academy. The information received from the LRC was primarily on evacuations of structures during fire or other emergencies within the building. These case studies and

articles were of limited value in research as it related to large-scale evacuations. The most useful information that was gleaned from these papers was the commonalities between all evacuations, regardless of size. The recurring actions of people that were affected could be observed and used for future evacuation planning.

Concurrently with the research being conducted through case studies and literature reviews, interviews were being conducted with people who have had experience during actual evacuations. The people contacted for interviews were Debbie Steffen, Director of the San Diego County Office of Emergency Services (OES), Scott McClintock, Sheriff Commander with the San Diego County Sheriff's Department, August Ghio, Deputy Fire Chief with the San Diego Fire and Rescue Department and David Ott, Fire Chief for the Solana Beach and Del Mar Fire Departments. Susan Asturias, Senior Emergency Services Coordinator for the San Diego County OES was also contacted because of her role in the San Diego County EOC during the wildfires of 2003. Ms. Asturias provided information and contact information for Scott McClintock but was not interviewed and did not provide information directly included in this report.

The interview with Debbie Steffen, Manager for the San Diego County EOC during the 2003 wildfires took place on January 12, 2007 via telephone. She was asked questions regarding the decision making process as it related to evacuations during the 2003 wildfires. Specific questions posed to Steffen were as follows:

1. Were evacuations ever ordered?
2. Were most of the fatalities in transit?
3. What changes have been made to improve communications from the field to the EOC?

4. How were people informed of the areas to evacuate?
5. Are there any other technologies that may be used to assist with evacuations?
6. Has Reverse 911 been used on other incidents that you know of?
7. Can partial evacuations be used effectively?
8. Who called for the evacuations at the Paradise fire.
9. Who made the call to evacuate at the Paradise Fire?
10. Was a local emergency declared?
11. Has there been any risk analysis of protect-in-place vs. evacuation?
12. Has there been any modeling about how many people can actually be expected to move during an evacuation?

The interview with Scott McClintock, who was a commander with the San Diego Sheriff's Department (SDCSD) took place on January 15, 2007 via telephone. Commander McClintock was the Manager for the SDCSD Department Operations Center (DOC) during the wildfires of 2003. He was asked questions regarding the decision making process as it related to evacuations during the 2003 wildfires. He was also responsible for researching and producing SDCSD training bulletins regarding evacuation procedures that are referenced in this report. Specific questions posed to McClintock were as follows:

1. Was there a formal direction to evacuate?
2. Were most of the fatalities in transit?
3. Is there any modeling for moving people during evacuations?
4. Were any trigger points established to determine when an area would be evacuated?

5. Were there any partial evacuations?
6. What actions have been taken to make evacuations more effective in the future?

A personal interview took place with August Ghio on May 9, 2007 in his office. Ghio was present in the San Diego Fire Department's Department Operations Center (DOC) in the role of DOC manager during the Cedar Fire. He was asked questions regarding the decision making process as it related to evacuations during the 2003 wildfires. Specific questions posed to Ghio were as follows:

1. What was your role during the Southern California Wildfires of 2003?
2. Was an evacuation ordered from the DOC?
3. What areas were evacuated?
4. How did the evacuation go?
5. Were people in front of the fires protected-in-place as opposed to being evacuated?
6. How did the protect-in-place efforts work?
7. Where did people die in the fires?
8. Were there trigger point for further evacuations?
9. Is there any modeling for moving people during evacuations?
10. What lessons were learned as related to emergency evacuations?

A personal interview took place with David Ott on May 10, 2007 in his office. Ott was in the North County Dispatch Joint Powers Authority (NCDJPA) dispatch center acting in the role of Zone Coordinator during the 2003 Southern California wildfires. He was in contact with the San Diego County EOC and the San Diego Fire and Rescue

Department DOC and was responsible for both receiving information and disseminating information between field commanders and city management. Ott provided information regarding available resources within the zone and support for evacuation activities. He was asked questions regarding the evacuation efforts during the 2003 wildfires. Specific questions posed to Ott were as follows:

1. What was your role during the Southern California Wildfires of 2003?
2. Was an evacuation ordered on the Paradise Fire?
3. Were there trigger point for further evacuations?
4. How did the information get relayed to the public?
5. How soon did the evacuation information get relayed to the public?
6. Were people in front of the fires protected-in-place as opposed to being evacuated?
7. How did the protect-in-place efforts work?
8. Where did people die in the fires?
9. Is there any modeling for moving people during evacuations?
10. What lessons were learned as related to emergency evacuations?

The information received from the interviews was compiled and compared to the information that was received from the case studies. The quantifiable data that was presented was frequently consistent with the interviews and articles reviewed. This information was evaluated and included in this report to address the research questions. The information is the basis for the results and the recommendations of this research project.

Assumptions and Limitations

There were not any books published on the subject of large-scale evacuations. This required the research to be focused on interviews of people involved in large-scale evacuations and case studies. The case studies of other large-scale evacuations were available and became the most prevalent source of information. It would be presumptive to infer that all evacuations were conducted under similar circumstances. The differences in types of disaster and pre-disaster notification can be assumed to have an effect on the effectiveness of an evacuation. The attempt was made to reconcile these differences in order to best evaluate evacuation planning as it relates to Southern California and the hazards most prevalent in the region.

The interviews that were conducted were of management level personnel in an EOC or DOC during fire evacuations. These people also served in the capacity of Emergency Preparedness Coordinator and/or Emergency Response Director for their respective agencies. They are subject matter experts on the subject of evacuations with real life experience to support their positions. These interviews cover a fixed period of time and it is always desirable to interview more subject matter experts over a larger geographical area and a broader period of time.

Attempts were made to locate computer simulated evacuation models. Although Steffen in her interview referred to Hazus modeling, there were not any evacuation simulators available to assist with determining the amount of people that could be moved in an evacuation. Research did locate a vendor in Florida that sells a commercially available evacuation simulator, however the budget of the research project did not allow

for the purchase of this product for the project. This made quantifying the exact amount of people that could be moved in a disaster an estimate rather than a hard number.

During the course of the research it became apparent that planning an evacuation solely for the City of Solana Beach was unrealistic. Because of the contiguous borders with neighboring cities to the north and south and the County of San Diego to the east, the potential for an evacuation affecting an area greater than Solana Beach is much higher than the potential of evacuating just one city.

The San Diego County OES has recently released the draft evacuation plan for San Diego County. Because of the timing of the draft plan, there was not time to evaluate it and put that information into this report. The attempt was made to evaluate evacuation plans and procedures that have taken place in the past for effectiveness and recommendations.

Results

The literature review and interviews resulted in information that varied depending on the type of incident, location in the Country and amount of advance warning before the incident occurred. The consistent message that was received from all sources was that if time allowed, evacuation was the best way to protect lives. In the instances of Taft, Louisiana and Nanticoke, Pennsylvania the evacuations were successful and resulted in a higher level of protection to the communities. In the Baton Rouge, Louisiana and Houston, Texas evacuations people died during the evacuation process. This answers the second question in this report. Evacuation is the best way to protect lives in a large-scale incident.

The Sandia Labs research produced interesting insight. The person and position of the person that delivered the information on evacuation changed the possible reaction of the public. The type of incident and the person's experience with the disaster had an effect on the reaction of the person. The gender of the person also affected the reaction. This information must be taken into account and utilized in order to make the evacuation as effective as possible. The information must be timely, concise and provide details. It ideally will be delivered either by the mayor, city council member or police or fire chief in order to have credibility and get the desired results.

An equally important aspect on which to focus is the type of incident itself. In the interview with McClintock and the review of the training bulletins released by the SDCSD, the stated procedure was for the first arriving deputy to make contact with the incident commander and assist making decisions as they related to evacuations, if time allowed. If not, the deputies were expected to make the decision to evacuate in the field. This decision will typically be made in a matter of minutes. This is a reality of the types of incidents most likely to occur in Southern California. The highest probability of evacuation in Southern California would be due to a wildfire or earthquake. These types of incidents are going to require rapid decision making with partial information regarding to the status of the incident. Evacuations for these incidents are going to be most successful with advance preparation, planning, public education and early notification. Other potential hazards to the region such as tsunamis, hazardous materials incidents, nuclear incidents or acts of terrorism will typically allow more time to evaluate the risks of the incident and the benefits of an evacuation. These incidents will also benefit from the proactive approach mentioned above.

Research never attached a fixed number to answer the first question of the research paper, how many people can emergency responders expect to move in a large-scale disaster? The most accurate answer that was observed was that the number of people evacuated depends on the specific situation. The type of emergency and the amount of advance notice affects the ability to move people. An evacuation will be more successful before the disaster hits than during the emergency. If a community has practiced the evacuation process the likelihood of a successful evacuation is greater. There were no software programs or other planning tools located during research to quantify the number of people that can be expected to move if a large-scale incident occurs. Research only indicated that there were possible actions that could maximize the number of people that could be moved safely.

The third question of this report explores the comprehensiveness of current evacuation plans. Research indicated that the evacuation planning that has taken place in San Diego County will protect people threatened by a potential disaster. Research also supports the position that current evacuation planning is not as comprehensive as it needs to be. Procedures need to be clearly documented as to how to receive, evaluate and release information regarding a dangerous incident. Public education campaigns need to be expanded, repeated and made consistent throughout all eighteen municipalities and the unincorporated areas. Exercises need to be conducted to condition the behavior of the public in a stressful period. These actions will best prepare the region for the hazards that are most likely to occur, and give emergency planners the best tools available for all types of emergencies.

Research indicates that evacuation planning is an important part of the emergency preparedness process in Solana Beach or any other city. The practicality of attempting to move the entire city needs to be evaluated on an incident by incident basis, however research stated that an important aspect of a successful evacuation is practicing the plan. Many of the potential emergency evacuation scenarios that face Solana Beach result in the potential of moving people for their protection. Wildfires, hazardous materials incidents and earthquakes could all result in the need to evacuate residents, visitors and people working in the city for their safety and protection. The nature of disasters that face the Southern California area typically give little advance warning. This needs to be built into the planning process to make evacuations safe and effective.

Discussion

The intention of the case studies was to explore the possibility of evacuation prior to or during a large-scale incident in San Diego County. The focus of many media reports following recent natural disasters has been on the need to evacuate large amounts of the public and the benefits of an organized evacuation. The discussion needs to revolve around the questions on this research paper, how many people can emergency services providers expect to move in a large-scale emergency? Is evacuation the most effective way to protect the community in a large-scale disaster? Are current evacuation plans comprehensive enough for evacuation in the event of a large-scale emergency?

Research indicated that evacuation can take many forms. It can be planned and practiced as indicated in the Nanticoke metal processing plant fire or it can be determined in the field and conducted while the danger is bearing down on the homes as demonstrated in the Cedar Fire. It also indicated that attempting to move a large portion

of the population of Solana Beach and its visitors is dependent on the amount of time and resources available to the local jurisdiction. Attempting to move a lot of people in front of a fast moving hazard with little advance warning and few resources will not be as effective as providing accurate information to the public and attempting to protect them in their homes. With time, planning, resources and practice, an evacuation can be utilized and the potential of protecting lives will be high.

Planning for an evacuation should include preparation for the members of the community that may have special needs. The elderly, the young and those with special needs may require special assistance and it is the responsibility of the emergency planner to take these needs into consideration when preparing for an evacuation. These members of the community will require additional resources if they are to be moved and it is imperative that these arrangements are made in advance if the evacuation is to be successful. Planning, education, public notification and exercises are even more important when preparing to evacuate the at-risk members of our community.

The San Diego wildfires of 2003 resulted in an evacuation effort that was decided by field personnel according to Scott McClintock, a San Diego County Sheriff Commander who was the director of the Sheriff's Department Operations Center (DOC). This approach has been reinforced by SDSO training bulletins developed by McClintock that direct responding sheriffs to an incident command post (ICP) to receive direction from the incident commander (IC). The sheriffs are then tasked with carrying out the direction of the IC with a boots on the ground approach. If the sheriff is unable to make contact with the IC or the IC doesn't give direction on the need for an evacuation, the deputy is tasked with making the decision to evacuate any home in the path of the fire on

their own. This approach was created out of necessity because of the rapid onset of a large-scale natural disaster but it should not be the model to which evacuation planning should aspire. A model evacuation should follow guidelines developed in advance that reflect a well developed plan, an organized approach to community education and a multi media mass notification approach when the incident occurs.

The interview with Debbie Steffen, Director for the San Diego County Office of Emergency Services (OES) and the Director in the San Diego County EOC, was similar. Steffen stated that the decision to evacuate was never made in the EOC, but most of the people that died in the fire perished while trying to move and were over run by the fire. This resulted in the focus on the need for quality community notification. Steffen stated in her interview that the Emergency Alert System (EAS) was largely ineffective, in part due to the fact that the she could only release County wide information when the need was for specific information depending on the location in the County. Steffen added in her interview that a telephone based community notification system (often called Reverse 911) was being explored by County OES. This system has since been purchased and tested for effectiveness in Solana Beach.

The interview with Ghio resulted in similar findings. By the time San Diego Fire and Rescue DOC management personnel decided to evacuate people in the Cedar Fire, they were already being moved by field personnel. There is a common thread of information from the firestorms of 2003. The hazard was moving too fast for information to be received by field personnel, relayed to the EOC or DOC, evaluated, a decision made, relayed to field personnel and then take actions required in time. It is imperative

that the emergency planners act in a proactive fashion to protect lives in an emergency situation.

The information that was consistently identified in research has been repeated many times in this report. Evacuation is the best way to protect lives in a large-scale incident. In order for an evacuation to be effective it must be planned and practiced. This includes written plans outlining lines of communication for the emergency responders, evacuation routes and public notification. Actual drills must be conducted to condition the public's actions under stressful conditions. If these steps are not taken, the evacuation has the potential for putting people in harm's way and causing loss of life. This coordinated approach to preparing for a worst case scenario is the best case for evacuation planning.

Recommendations

The importance of an evacuation plan has been demonstrated in real-life examples such as the chemical tank explosion in Taft, Louisiana in January of 1983. The After Action Report of that incident reported that one of the important factors that led to a successful evacuation was practicing the plan after it was developed. The City of Solana Beach will be more prepared to evacuate people should the need arise if an EOP containing an evacuation annex is in place. It will be beneficial if after the annex is adopted, the fire department organizes a full scale exercise to practice the plan and identify strengths and areas to improve. This exercise enhances the probability of a successful evacuation during the high risk circumstances of an evacuation under emergency conditions.

A public education component is an important aspect of a successful evacuation. It is critical that the public has a general understanding of how an evacuation will be announced and what their expected actions are for the evacuation to minimize the risk of injury or death while maximizing the ability to move people. The City of Solana Beach has multiple media at its disposal to educate the public. Because of the number of people who receive information via the internet, evacuation information should be placed on the City and Fire Department websites. The City newsletter can contain a small piece on the evacuation plan with a location listed where people can go to receive more information. Public education such as CERT classes, 'Are You Ready Solana Beach' presentations and the Public Safety Commission meetings are all opportunities to explain the evacuation plan to the community. The key to a successful community education program will be to engage as many media as possible to reach as many people as possible.

At the April 19, 2007 Unified Disaster Council (UDC) meeting, the public safety directors from all the incorporated cities in San Diego County and a representative from the County adopted Annex Q to the San Diego Operational Area Emergency Operations Plan (EOP). Annex Q formalizes the evacuation process in San Diego County. Discussion preceded adoption of the annex regarding the specificity of the plan as it relates to individual cities and it was agreed that the annex was a guideline meant to help the cities develop more specific plans. The City of Solana Beach should adopt Annex Q into the City EOP and should make the evacuation procedures specific to the City. This plan would serve as the evacuation component of the City EOP and serve as the foundation of future exercises and emergency responses as needed.

The final element of a successful evacuation is timely, accurate information to the public during a possible or actual evacuation scenario. Methods to receive the information should be included in all public education presentations and a multi tiered approach should be utilized if an actual evacuation is warranted. The EAS should be used to reach people who are watching TV or listening to the radio. The community emergency notification system should be initiated to reach as many people as possible by phone. The City and Fire Department website need to be updated as soon as the information is available to reach people via the internet. Phone lines to the City and the Fire Department need to be provided with current, recorded information to direct the actions of members of the community. While the Sandia labs study stated that people will tend to listen to the fire chief or the mayor, the Connecticut Emergency Broadcast System survey was very clear on this message. People will look for confirmation once they have heard a notice to evacuate. We must put out clear, consistent information if we want to influence the behavior of a large portion of the public under stressful conditions.

The City of Solana Beach can explore the possibility of conducting an Evacuation Time Estimate (ETE). Research located commercially available software and consultants that could be used to quantify the number of people that could be moved under emergency conditions. The City should explore these possibilities to have additional information available if EOC personnel need to make a decision to evacuate. It can also be incorporated into emergency plans and training before an emergency situation to assist personnel in the field to make decisions on evacuations. It has been demonstrated that this could be where the decisions may be made during the early stages of an emergency.

An ETE could be an effective tool to be included in the evacuation planning and preparation process for Solana Beach.

These recommendations are designed to assist the SBFD prepare for an evacuation due to a large-scale incident. Research has indicated that for evacuations to be most successful, they require a proactive approach prior to the day of the incident. This is the foundation upon which emergency preparedness is based and evacuations are one part of emergency preparedness. These recommendations are the result of answering the three questions in this research project, how many people can emergency service personnel expect to move in a large-scale emergency? Is evacuation the most effective method to protect the community in a large-scale emergency? Are current evacuation plans comprehensive enough to facilitate evacuation in the event of a large-scale emergency?

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