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Assessment of Emergency Response Planning and Implementation for Large Scale Evacuations

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Abstract

Evacuation is a key protective action element in the emergency preparedness plans for nuclear power plants (NPPs). Following the devastating hurricane season of 2005, the nation recognized the need to review emergency response planning. The NRC has sponsored this study to assess Hurricanes Katrina, Rita, and Wilma, as well as other large scale evacuations from which lessons learned may further enhance the emergency preparedness program for radiological emergencies at NPPs. Evacuations related to these incidents have brought to light issues that have not been previously encountered during large scale evacuations. The knowledge gained from studying 11 large scale evacuations is used to determine if the emergency planning activities were effective in managing the response effort. The 11 incidents covered wide geographical areas and affected 14 NPP Emergency Planning Zones (EPZs). None of the evacuations were related to the NPPs. Discussions with emergency response personnel confirmed that response to many of these incidents benefitted from the use of some of the emergency planning elements developed for the EPZs. Research of evacuations such as these provides an opportunity to understand contributing factors that support the effectiveness of emergency response activities. A key finding of this study is that emergency planning for NPPs has substantially anticipated and addressed the issues identified in the large scale evacuations researched. Insights and lessons learned are identified, and suggestions are provided for possible enhancements to the NRC and FEMA emergency preparedness program.

Paperwork Reduction Act Statement

The information collections contained in this NUREG are covered by the requirements of 10 CFR Part 50, which were approved by the Office of Management and Budget (OMB), approval number 3150-0011.

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EXECUTIVE SUMMARY

In the summer of 2005, Hurricanes Katrina, Rita and Wilma made landfall in the United States testing the emergency preparedness community to the fullest extent and brought to light some issues that have not been previously encountered in large scale evacuations. Most assessments conclude that the evacuation for Hurricane Katrina was successful, in terms of traffic management (United States, 2006a), but for those who did not or could not evacuate, the results were often catastrophic. A larger evacuation for Hurricane Rita, only 3 weeks later, was by most accounts a failure; the biggest failure of which was communication to the public (HRO, 2006). Research of evacuations such as these provides an opportunity to understand contributing factors that support the effectiveness of emergency response activities. This study included research on 11 large scale evacuations. In eight of the 11 incidents, the hazard or response encroached upon nuclear power plant (NPP) Emergency Planning Zones (EPZs) affecting a total of 14 EPZs. For some of these incidents, elements of emergency planning for the EPZs were utilized and benefitted response activities. A key finding of this study is that existing emergency planning requirements for NPPs substantially anticipate and address issues identified in the 11 large scale evacuations researched.

For the high profile evacuations studied many formal lessons learned have been developed and changes to improve response capabilities are in progress or have been implemented. Several important concepts related to improved response were identified in this research including:

- Regional resources are being integrated into large scale evacuation planning;
- Evacuation techniques improve when tested;
- Enhancements in emergency communications improve response effectiveness;
- Information provided to evacuees while en route during an evacuation is beneficial; and
- Improved planning for special needs individuals who do not reside in special needs facilities is needed.

Figure ES-1 summarizes planning and implementation effectiveness of the seven emergency response elements evaluated in this study. A major observation is that the effectiveness of

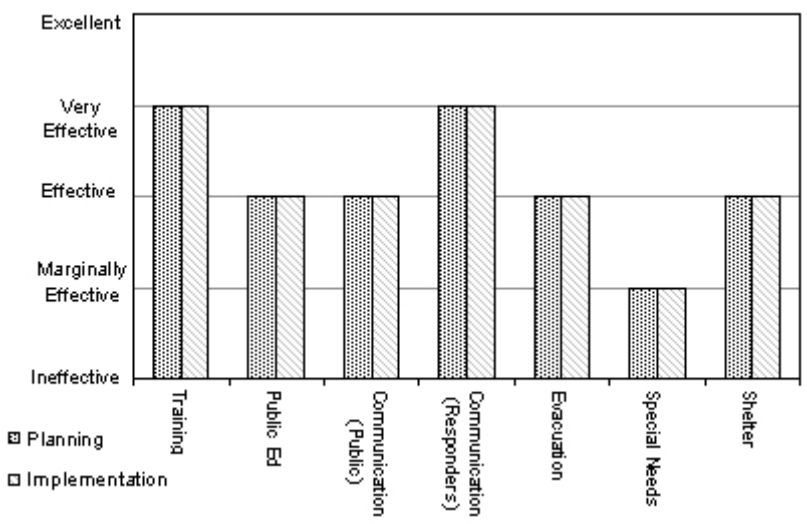

Figure ES-1 Rating of Seven Emergency Response Elements

implementation was directly related to the level of planning. What is also clear was that the effectiveness in addressing special needs was rated less than other planning elements. The observations of this study, as reflected in Figure ES-1, show that when the level of resources applied to an emergency preparedness element is sufficient, the implementation of that element is sufficient. For instance, training and communication among emergency responders have received additional resources in the last few years, which contributed to the very effective rating. Public education, communication with the public, evacuation, and sheltering are rated effective. Only the special needs category was rated less than effective based largely on the lack of planning for special needs individuals who do not reside in special facilities and on problems encountered with special facilities in response to Hurricanes Katrina and Rita. Existing NPP requirements largely address and mitigate the issues that caused the lower ratings for the evacuations studied.

Emergency preparedness for NPPs is regulated by the NRC in 10 CFR 50.47 and Appendix E to 10 CFR Part 50. These regulations include requirements that address and mitigate the difficulties experienced in the large scale evacuations assessed in this study. The NRC bases its licensing decisions, in part, on its assessment of the onsite capabilities and on a review of FEMA's assessment of the offsite capabilities. These onsite and offsite capabilities for NPPs include comprehensive coordination of resources, dedicated support services, warning and notification systems, and frequent and thorough cross jurisdictional training and exercises. Decision processes are established and tested; communication resources are planned, implemented, and tested; and infrastructure is assessed to understand the potential impacts during an evacuation.

A review was conducted of NRC and FEMA emergency preparedness regulatory, programmatic and guidance documentation to compare the existing emergency preparedness program with the seven emergency planning elements. The regulatory review demonstrated that existing criteria, plans, and procedures are already in place to address most of the issues that were experienced in the large scale evacuations studied. These regulatory requirements and guidance are well established, and lessons learned from this study may further enhance the emergency preparedness program. It is recommended that the NRC and / or FEMA emergency preparedness program consider offsite planning enhancements to better address the following:

1. Special needs individuals who do not reside in special facilities;
2. Special needs individuals in congregate care centers;
3. Integrating a regional approach to evacuations;
4. Availability of resources for special needs individuals and special needs facilities;
5. Communication to the public who are not in the affected area to support staged evacuations and mitigate shadow evacuations;
6. Pets at congregate care centers.

These recommendations were developed after review of the selected evacuations which had brought to light issues that have not been previously encountered in large scale evacuations including the catastrophic impacts for residents that did not follow evacuation orders, resources for special needs facilities being unavailable, and shadow evacuations affecting the evacuation of risk areas. These issues occurred primarily in response to Hurricanes Katrina and Rita when authorities deviated from the emergency response planning and procedures that were in place.

Such deviations are not likely to occur within the NPP emergency preparedness program because of frequent and thorough training, drills, and exercises which are regularly inspected. In addition the NRC and other Federal agencies would immediately be involved in the unlikely event of an NPP accident providing oversight that would reduce any potential for deviation from emergency response planning and procedures. The prospective offsite planning enhancements identified herein could further strengthen the emergency preparedness program.

ACKNOWLEDGMENTS

Following the devastating hurricane season of 2005, the nation recognized the need to review emergency response planning. The NRC, in a proactive effort, has sponsored this study to assess Hurricanes Katrina, Rita, and Wilma, as well as other large scale evacuations from which lessons may be learned that could further enhance the existing emergency preparedness program. In support of this activity, the NRC Technical Leader, Patricia Milligan, provided the technical leadership to ensure this project met the needs of the emergency preparedness program. Randy Sullivan, Kathryn Brock, and Steve LaVie provided technical insights supporting key elements of this project. Don Johnson was the NRC project manager responsible for contractual matters. Joe Jones led the project team for Sandia National Laboratories and performed the technical assessments of the evacuations in this study. J. D. Smith of Sandia provided technical support to the project and supported the field investigation efforts. Ms. Fotini Walton performed extensive research for Sandia National Laboratories to support development of case studies and supported the development of the technical report. Dr. Brian Wolshon, Associate Professor at Louisiana State University Hurricane Center, supported the research and development of this study, performed technical review of this report, and provided insights and consultation based on his extensive experience in evacuation and transportation assessments related to hurricanes.

ACRONYMS

ADA	Americans with Disabilities Act
ARCA	Area Requiring Corrective Action
CDF	California Department of Forestry
DHS	Department of Homeland Security
DOE	Department of Energy
DOT	Department of Transportation
EAL	Emergency Action Limit
EAS	Emergency Alert System
EOC	Emergency Operations Center
EOM	Emergency Operations Manager
EPA	Environmental Protection Agency
EPP	Emergency Preparedness Program
EPZ	Emergency Planning Zone
ERT	Emergency Response Team
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
ICS	Incident Command System
JIC	Joint Information Center
LEPC	Local Emergency Planning Committee
MAST	Mountain Area Safety Taskforce
MEMA	Mississippi Emergency Management Agency
NHC	National Hurricane Center
NIMS	National Incident Management System
NPP	Nuclear Power Plant
NRF	National Response Framework
NRP	National Response Plan
PIO	Public Information Officer
SEMS	Standardized Emergency Management System

1.0 Introduction

On August 29, 2005, Hurricane Katrina made landfall east of New Orleans, Louisiana, becoming the most costly natural disaster in the history of the United States. Hurricane force winds and storm surge of almost 10 meters (about 33 feet) caused extensive damage throughout Louisiana, Mississippi, Alabama, and Florida. The failure of levees that protected New Orleans caused catastrophic flooding throughout the city and brought to light problems related to Federal, State and local post-hurricane response. In the weeks following Hurricane Katrina, Hurricanes Rita and Wilma made landfall along the Gulf Coast. Although these events occurred within six weeks of each other, the emergency response activities and the public response to the evacuations varied greatly.

Previous studies of large scale evacuations implemented in the last 30 years (Witzig, et al, 1987; Weston, 1989; NRC, 2005a) identified that in the United States, evacuations of more than 1,000 people occur about three times a month and generally proceed safely. When casualties did occur, they were typically due to the hazard, and deaths during evacuations were rare in these studies. The casualties that resulted from the recent hurricanes are not typical of evacuations and warrant extensive review to understand the differences in the response or hazards that may have contributed to the number of casualties. Lessons learned from these incidents, along with additional selected evacuations, are investigated herein to support a better understanding of the implementation of protective actions in response to large scale incidents. The knowledge gained from this study was used to determine if lessons learned from these incidents could be used to enhance the NRC and / or Federal Emergency Management Agency (FEMA) emergency preparedness program.

Most assessments conclude that the management of evacuation traffic for the Gulf States in response to Hurricane Katrina went very well (United States, 2006a). Approximately two million people evacuated from Louisiana, Mississippi and Alabama. However, not everyone followed the evacuation orders, with some people either choosing to stay behind or not having the ability to evacuate. Although many individuals in Louisiana did not evacuate for Hurricane Katrina, the cause for such decisions was not due to traffic congestion but is largely attributed to the late decision to order a mandatory evacuation of New Orleans. The Failure of Initiative (2006a) states “the incomplete pre-landfall evacuation led to deaths.” In contrast with the ability to manage traffic during the evacuation for Hurricane Katrina, the evacuation in response to Hurricane Rita approximately three weeks later was so poorly orchestrated around Houston, Texas, that tens of thousands of residents turned around and went home after being stranded in traffic for many hours. The biggest failure of the Hurricane Rita evacuation was communication to the public (HRO, 2006). Understanding the causes for the difference in response to similar threats may be beneficial in identifying enhancements in emergency planning for NPPs, recognizing that any such evacuation for a NPP would cover a much smaller geographic area and far fewer individuals.

The events of 2005 provide an excellent opportunity to develop lessons learned in emergency response and alone could provide significant knowledge. Hurricanes provide an excellent basis for assessing emergency planning, but there are some aspects of hurricanes that may not be directly applicable to the NRC and / or FEMA nuclear power plant (NPP) emergency preparedness program. The approach time and the seasonal nature of hurricanes provide

opportunities for emergency response agencies that are not always available for other types of hazards. To provide a multi-hazard assessment, the initial scope of this study included a diverse set of ten large scale evacuations. In October 2007, near the end of the research, a series of fires occurred in southern California prompting the evacuation of almost one million people. The magnitude of the California evacuations and the timing of the incident provided an opportunity for the NRC to add a valuable addition to the scope of this study. The additional scope included reviewing the lessons learned from the 2003 California fires and assessing the effectiveness of implementation of these lessons learned during the 2007 California fires. Thus, in total, eleven evacuations were studied.

The eleven evacuations selected for research ranged from 3,000 to over 3 million evacuees. The evacuations studied were distinctly different for a variety of reasons including geographic location and complexity of the events. For the hurricane evacuations, which may involve millions of people over hundreds of thousands of square miles, it is important to recognize how the geographical size affects the response. To put these natural disasters in perspective with NPP emergency planning, the geographic size of the hazard and areas affected must be understood. In NUREG-0654/FEMA-REP-1, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants", an Emergency Planning Zone (EPZ) around an NPP is established as about 16 km (about 10 miles) with the understanding that detailed planning within 10 miles would provide substantial basis for expansion of response efforts in the unlikely event that this proved necessary (NRC, 1980). Hurricane Katrina, by comparison, was approximately 640 km (400 miles) across. Figure 1.1 depicts Hurricane Katrina as it approached the Gulf States. The 16 km (10 mile) EPZs for River Bend and Waterford NPPs are also shown in the figure to provide a perspective of geographical size difference.

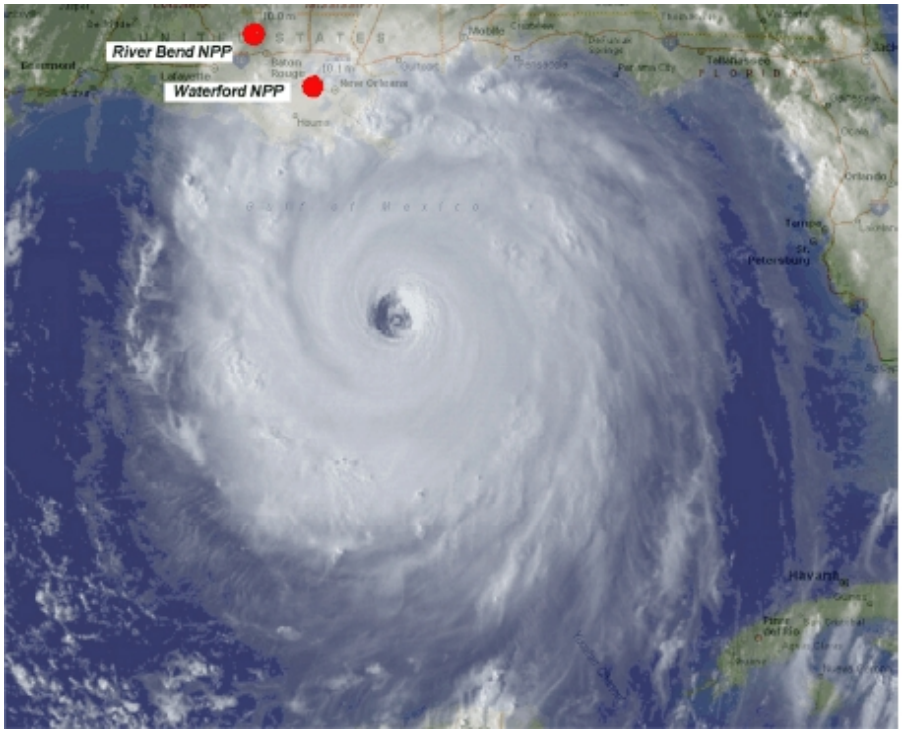

Figure 1.1. Hurricane Katrina approaching the Gulf Coast States. The 16 km radius (10 mile) EPZs for Waterford and River Bend NPPs are shown to scale demonstrating the size difference between evacuation of a 10 mile EPZ and evacuation for a hurricane. (Scale 1" ≈ 160 miles)

A second important factor is the affected population. Hurricanes frequently require evacuation of more than 1 million people and can directly impact hundreds of communities whereas large population EPZs may include about 20 communities. The ten NPP EPZs with the largest populations range from approximately 140,000 people to over 300,000 people (FEMA, 2005a). These populations do not represent seasonal changes such as beach populations or other transient populations that may be within the EPZ; nonetheless, the data provides a good comparison to the large population difference between EPZs and the populations affected in the incidents assessed herein. In the unlikely event of an NPP emergency that might require an evacuation, a keyhole approach would likely be implemented in accordance with NRC guidance in Supplement 3 to NUREG - 0654 (NRC, 1996). A keyhole includes evacuating the 3.6 km (2 mile) ring around the NPP and at least three 22.5 degree sectors. This area equates to about 20 percent of the EPZ. The public residing within the keyhole area would evacuate to locations outside of the EPZ. The required travel distance to safely exit the hazard area is significantly shorter than needed for a hurricane. Congregate care centers are typically established between 5 and 10 miles outside of the EPZ (NRC, 1980).

When hurricanes approach States within which there are EPZs, elements of the emergency planning for the EPZs are inherently utilized, and in some instances proactively utilized to support the response. For the hurricanes researched, the pre-landfall emergency response activities was the main focus. To some extent the post-landfall activities, were researched when consequences may potentially have been avoided if earlier protective actions had been more successful. Due to the availability of information, the emphasis of this project was on Hurricane Katrina; however, all eleven case study evacuations within this report were thoroughly researched to understand the emergency response activities and the lessons learned from each incident. Detailed case studies are included in Appendix A, Case Studies. Within emergency response organizations and regulatory bodies, definitions of common terms, although generally consistent, have been found to vary in some cases. For this reason, a glossary is provided in Section 8.0 defining terms that may not be familiar to non-emergency response personnel and terms that may have different interpretations when used in other context.

1.1 Objective and Scope

The NRC intends to use the knowledge gained from recent large-scale emergency response activities as a resource to determine if the emergency planning activities that were available and implemented were effective in managing the response effort. The objective of this study was to determine if there are areas within the NRC and / or FEMA emergency preparedness program that may be enhanced based on lessons learned, and to identify where the program may have already anticipated and addressed elements that may not have been effective in the major evacuations studied. To accomplish this objective, the scope of the project included:

- Identifying eleven large scale evacuations for evaluation;
- Reviewing the level of planning in place for each evacuation;
- Assessing the extent to which the planning was implemented in the emergency response;
- Identifying key factors that affected the implementation and response to evacuations;
- Comparing the assessment of the evacuations to the NRC and FEMA emergency preparedness program elements; and
- Reviewing the 2007 California fires to assess implementation of lessons learned.

When available, emergency planning documentation in place at the time of each incident was reviewed to provide a basis in determining the effectiveness of planning and implementation. The evacuations studied included Hurricanes Katrina, Rita, and Wilma in 2005, Hurricane Ivan in 2004, and Hurricane Georges in 1998. The remaining evacuations studied were selected based on a qualitative assessment derived from the process used in NUREG/CR-6864, "Identification and Analysis of Factors Affecting Emergency Evacuations" (NRC, 2005a).

1.2 Background

NRC recognizes the benefit of assessing large scale evacuations to determine where enhancements in the emergency preparedness program may be beneficial. In 2003, NRC initiated efforts to assess large scale emergency evacuations, and in January 2005, the NRC published NUREG/CR - 6864 "Identification and Analysis of Factors Affecting Emergency Evacuations" (NRC, 2005a), which presented a comprehensive investigation of public evacuations in the United States. The data collected during that study has proven valuable in identifying emergency planning activities, public behavior, and other trends observed during evacuations.

In response to the 2005 hurricane season, the NRC, interested in lessons learned for itself and licensees, established the 2005 Hurricane Season Lessons Learned Task Force. This Task Force was chartered to develop a set of lessons that can be applied to natural phenomena. The NRC published the "Task Force Report, 2005 Hurricane Season Lessons Learned" (NRC, 2006), which included the following three Priority 1 recommendations:

(1) The NRC should assess agency communications equipment and services associated with emergency notification systems and recommend improvements in diversity and reliability.

(2) By May 10, 2006, the NRC should improve existing natural phenomenon response procedures for reactor and fuel facilities and materials licensees to clearly define roles and responsibilities, provide responder guidance, and to be consistent across the regional offices.

(3) By June 1, 2006, the NRC should improve consistency and apply best practices in dispatching and maintaining accountability of responders and site staff. The accountability of staff should be highly visible.

There were eight Priority 2 recommendations in the Task Force Report, one of which was that the NRC utilize the information from the evacuations following Hurricanes Katrina and Rita to assess the impacts on the agency's emergency preparedness program (NRC, 2006).

Since the publication of NUREG-0654 / FEMA-REP-1, Rev. 1 (NRC, 1980), licensees and local and State agencies have developed detailed radiological emergency response programs. These emergency management programs for NPPs are mature and comprehensive, and evacuation is a key protective action within these programs. To support comprehensive planning, there is a desire to integrate lessons learned from other emergency management activities to better prepare for a response in the unlikely event of an NPP accident.

2.0 Methodology

To perform the research necessary to support gathering of lessons learned related to emergency preparedness, a methodology was employed which included identification of incidents, collection and analysis of information, and comparison to NRC and FEMA requirements and guidance for NPP emergency planning. This approach provides a direct means of identifying where insights and lessons learned may benefit the NPP emergency preparedness program. The approach included the following activities:

- Identification of incidents for investigation;
- Literature review;
- Field investigation;
- Analysis and rating of incident response elements;
- Review of NRC and FEMA regulatory and guidance documentation; and
- Development of a matrix to compare the NRC and FEMA requirements with the emergency planning elements.

Research included a comprehensive literature review, interviews of emergency response managers and responders, discussions with university staff, and site visits to California, Louisiana, Mississippi, and North Carolina to obtain detailed first hand information on the evacuations. Staff also attended the "Disaster Planning for the Carless Society Conference" in New Orleans, Louisiana on February 8 - 9, 2007 and the National Hurricane Conference on April 2-6, 2007 to meet with emergency responders, technical experts, and evacuees to learn about related issues.

2.1 Selection of Incidents

The scope of this study included evaluating the lessons learned from five hurricanes, the 2007 California fires and five additional evacuations. A qualitative approach was taken in the selection of the additional evacuations with emphasis on incidents that were large scale and had some unique attribute associated with the evacuation. For example, the Hawaii earthquake was selected because the evacuation included primarily special facilities. To select the five additional evacuations, a basic profiling was conducted following the criteria used in NUREG/CR-6864. Incidents were expected to have broad media coverage, and the emergency management personnel contacted were expected to have current and relevant knowledge of the incidents. The criteria for an evacuation to be considered for further study included the following:

- Evacuations of more than 1,000 people;
- Evacuations occurred between 2003 and 2006, with one evacuation in 1998; and
- Evacuations occurred within the United States.

Due to the timing of the 2007 California fires and the addition of this incident to the project after the initial assessments of the original ten evacuations were complete, a case study was developed for the fires, but the 2007 fires were not included in the assessment of effectiveness in Section 4.0.

Table 2.1 identifies the 11 evacuations selected for research. The approximate number of evacuees is difficult to identify precisely, and the values listed are generally available through literature. The total number of evacuees from these incidents approached 10,000,000 people.

Table 2.1. Large Scale Evacuations

Date	Incident	Name	State	# Evacuated (approximate)
September 1998	Hurricane	Georges	FL, MS, AL	1,200,000
October 2003	Wildfire	2003 Southern California Fires	CA	100,000
September 2004	Hurricane	Ivan	FL, NC, MS, GA	2.3 million
August 2005	Hurricane	Katrina	LA, MS, AL, FL	2 million
September 2005	Hurricane	Rita	TX, LA	3 million
September 2005	Technological	Chemical Fire Romulus, MI	MI	3,000
October 2005	Hurricane	Wilma	FL	300,000
May 2006	Flood	New England Flooding	NH, MA, ME	7,000
October 2006	Technological	Chemical Fire Apex, NC	NC	17,000
October 2006	Earthquake	Hawaii Earthquake	HI	3,000
October 2007	Wildfire	2007 California Fires	CA	900,000

2.2 Data Gathering

The data collection began with an extensive review of available literature to support the development of a case study for each evacuation. Hurricanes Katrina and Rita have resulted in many formal investigations and research efforts on these incidents continue. Most of the Hurricane Katrina publications relate to the post-incident casualties, but some investigations have assessed emergency planning; for example, the “Catastrophic Hurricane Evacuation Plan Evaluation” (DOT, 2006), which was performed by the United States Department of Transportation in cooperation with the United States Department of Homeland Security (DHS). This document as well as other government sponsored investigations and assessments were reviewed including “A Failure of Initiative, Final Report of the Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina” (United States, 2006a), and “The Federal Response to Hurricane Katrina Lessons Learned” (United States, 2006b).

Because of the multiple agencies and jurisdictions involved in large scale incidents, data

gathering can be an exhaustive effort. To focus these efforts, a data collection form was developed and included questions on the following topical areas:

- Hazard that caused the evacuation;
- Demographics;
- Community awareness of area hazards and potential protective actions;
- Emergency planning and response;
- Evacuation specific details;
- Special needs individuals and facilities; and
- Shelters.

The data collection form was populated with information from published literature, media reports and documented assessments of evacuation experiences. Information from State and local agencies, including emergency response plans and public information brochures developed by emergency management agencies, was also reviewed. Additional information sources included journal articles, books, conference proceedings, university research centers, and local and national news media.

2.3 Field Investigation

After the initial data gathering, a field investigation was conducted to obtain first hand information on emergency planning elements and implementation experience. The field investigation included contacting local, regional, and State response agencies that supported the evacuations. Field and telephone interviews were conducted with emergency responders, support personnel, university staff and, in some cases, evacuees. The data collection form was used to guide each interview.

The objective of the interviews was to obtain first hand information on elements of the emergency response. The interviews covered a wide range of topics related to the evacuation, including:

- Evacuation decision making
- Notification of response personnel and the public
- Public response
- Communications
- Traffic management and control
- Shelters
- Training and drills
- Special facilities
- Special needs individuals
- Community preparedness
- Consequences
- Shadow evacuations
- Unusual or special circumstances

When available, the emergency response plans for each incident were reviewed prior to the interviews to provide an understanding of the basis from which the response took place. Site visits were conducted in California, Louisiana, Mississippi, and North Carolina to meet with emergency response managers and personnel.

2.4 Analysis of Incident Response Elements

The emergency response for these large scale incidents was very broad, therefore a few important emergency planning elements were selected for detailed assessment. Elements were selected that are of most interest to the project and were expected to provide insights and lessons learned which may be of benefit to the NRC and / or FEMA emergency preparedness program for NPPs. Seven emergency response elements were selected for review including training, public education, communication with the public, communication with emergency response, evacuation, special needs, and shelters.

For the emergency response elements selected, a qualitative assessment of both planning and implementation was conducted. The assessment of planning was based on the level of detail included in the emergency response plans. The assessment of implementation was developed from information gained in the field interviews and data gathering process.

2.5 Comparative Assessment

A comparative assessment of the emergency planning elements was developed. The NRC and FEMA emergency preparedness program regulations and guidance documents used for the assessment were:

- 10 CFR 50.47 - Emergency Plans;
- Appendix E to 10 CFR Part 50 - Emergency Planning and Preparedness for Production and Utilization Facilities;
- Management Directive 8.2 - NRC Incident Response Program;
- NUREG-0728 - NRC Incident Response Plan;
- NUREG-0654/FEMA - REP-1, Rev.1 - “Criteria for Preparation and Evaluation of Radiological Emergency Response and Preparedness in Support of Nuclear Power Plants”;
- NUREG-0654/FEMA - REP-1, Rev.1, Supplement 3 “Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants” Draft Report for Interim Use; and
- 67 FR 20580, “FEMA Radiological Emergency Preparedness: Exercise Evaluation Methodology,” April 25, 2002.

3.0 Evacuation Case Study Overviews

The information obtained during the research and field investigations supported the development of detailed case studies for each evacuation incident. Case studies were developed to document the key activities and events that occurred and how these may have affected the success of the evacuation. A case study overview for each evacuation is provided below chronologically in the order in which the evacuations occurred with full case studies included in Appendix A, Case Studies. The information below is intended to summarize some of the important factors of each incident with much greater detail provided in Appendix A.

It is important to note that the precise values of evacuation numbers, damage estimates, areas affected, and number of deaths can vary among published reports. This is very typical of large scale evacuations, because responders are focused on the safety of the public and not on counting evacuees. For casualties, sometimes injuries sustained during the emergency result in death at a later date, thus the casualties listed may also change with time. The values identified in the case studies should be regarded as representative of the incident, but should not be considered official values.

3.1 Hurricane Georges (1998)

Overview:

- Approximately 1.2 million people evacuated.
- Evacuations were generally staged.
- Construction on Interstate 10 severely affected the traffic flow.
- Approximately 65,000 people sheltered along the Gulf Coast.
- The New Orleans Superdome, where 16,000 people sheltered, was used for the first time.
- The Superdome sustained some damage from those who sheltered.
- The EPZs for Turkey Point and Waterford NPPs were within the area affected by the hazard.

In September 1998, Hurricane Georges crossed the Florida straights and was projected to make a final landfall in Mississippi, prompting evacuation orders for approximately 1.2 million residents in coastal communities in Florida, Mississippi, Alabama, and Louisiana. The Gulf Coast communities had not experienced a large hurricane in many years. In New Orleans, the last hurricane that caused significant damage to the city was Hurricane Betsy in 1965. In Biloxi, Mississippi the last hurricane to cause major destruction was Hurricane Camille in 1969. Although more than a million people evacuated for Hurricane Georges, compliance was considered low. Emergency responders in Louisiana and Mississippi indicated that the length of time between these hurricanes was a factor in the low compliance to evacuation orders. Public compliance with evacuation orders was better in Mississippi than in Louisiana. Emergency managers agreed that many of those who stayed behind did so because they had survived Hurricane Camille or Betsy and did not believe that Hurricane Georges would be as destructive. Some of the problems recognized during the response included an over-reaction to the need to evacuate, insufficient planning, and limited coordination between various agencies responsible for evacuation (Wolshon, 2001).

Approximately 600,000 people evacuated in Louisiana. In Jefferson and Orleans parishes, only about a third of the residents ordered to evacuate actually left the area (Howell, 1998). Construction on Interstate 10 heading out of New Orleans reduced the Interstate to one westbound lane causing major gridlock for those trying to leave the city.

Approximately 65,000 people sheltered in the Gulf Coast States including about 2,500 special needs individuals (USACE, 1999). The New Orleans Superdome was used for the first time as a shelter of last resort, and approximately 16,000 were estimated to have used the facility. Evacuees looted and damaged the building, although it does not appear the damage was significant.

3.2 Southern California Wildfires (2003)

Overview:

- More than 100,000 people evacuated.
- Evacuations were staged.
- Shelter in place was implemented in select areas.
- More than 20 people died, many of whom were trying to evacuate from their homes (Mutch, 2007).
- Communications were difficult due to the terrain and the large number of fire fighters responding from different jurisdictions.
- More than 10,000 people used shelters.
- The Simi Fire burned approximately 80,000 acres in 16 hours (CDF, 2003).
- Special needs facilities and special needs individuals not residing in facilities were evacuated.

Beginning on October 21, 2003 and continuing through November 4, 2003, Southern California experienced the largest wildland urban interface fire in the State's history. The fast moving fires consumed 740,000 acres and required over 15,000 fire fighters to support the effort (CDF, 2004). Over 100,000 people evacuated their homes, and many of these people were from mountainous areas with very limited routes of egress. One of the largest single evacuation efforts was concentrated in San Bernardino County where mountain area residents evacuated after dark in areas without power. Previous community awareness programs in San Bernardino, such as the Mountain Area Safety Taskforce (MAST), and continuous efforts from emergency responders, were attributed to the success of this mountain community evacuation.

Evacuations in response to the California fires were staged with communities evacuated depending on the changing fire conditions. Major urban areas were threatened, miles of power lines were destroyed, communications were difficult, and numerous roads were closed. At least five interstates were closed at some time during the incident (CDF, 2004). The loss of infrastructure affected communications and limited evacuation routes. In some areas, residents were advised to shelter in place because routes of egress were closed due to the fire or because fire conditions were too dangerous to safely evacuate an area.

Emergency response agencies used multiple methods to communicate with the public (CDF, 2003). The Cedar Fire had moved quickly and evacuation notification for this fire was primarily

door-to-door contact or via loudspeakers on emergency vehicles. San Diego County normally would have used the EAS, but it was deemed impractical at the time because the information would be inaccurate due to the swiftness of the fire, and it was approaching midnight when many residents would not have their televisions or radios turned on to receive the EAS message (CDF, 2004). Although overall compliance was high, the constantly changing conditions resulted in a mixed response to the evacuation. Some people did not follow instructions provided by emergency responders, and a few individuals refused to evacuate. More than 20 people died from the fires, many of whom were trying to evacuate from their homes (Mutch, 2007)

3.3 Hurricane Ivan (2004)

Overview:

- Approximately 2.3 million people evacuated the Gulf States.
- Four elderly individuals in New Orleans died during the evacuation.
- The evacuation of coastal areas was generally staged.
- Traffic congestion caused delays up to 36 hours.
- Contraflow was implemented for the first time in Alabama and Louisiana with marginally successful results.
- Evacuees in all States had difficulty finding shelter or hotel rooms.
- The New Orleans Superdome was opened as a special needs shelter and later expanded as a shelter of last resort.
- Only 1,100 people sheltered in the Superdome.
- The EPZs for Waterford and River Bend NPPs were within the area affected by the hazard.

Hurricane Ivan was the strongest hurricane of the 2004 season making landfall near Gulf Shores, Alabama on September 16, 2004 as a Category 3 hurricane. Approximately 2.3 million people were ordered to evacuate from the coastal regions of Florida, Alabama, Mississippi and Louisiana. Although the evacuations in response to Hurricane Ivan were generally considered improved with respect to previous evacuations, many problems were encountered.

In Florida, emergency management had implemented response plans for Hurricanes Charley and Frances in the previous month. With this recent experience, post-storm reports still identified “mixed” evacuation messages being conveyed to the public (Wolshon, 2005) with early, voluntary, recommended, and mandatory evacuations being ordered throughout the region. In many cases the evacuation messages were changed during the hurricane watch. The time frame in which evacuation orders were issued was a problem for some evacuees. For instance, evacuation notifications were distributed as early as two days before tropical storm winds were expected to hit the coast, but residents were still expected to report to work. This caused some evacuees to leave later than they would have otherwise, aggravating already congested roadways.

In Louisiana, mandatory evacuations were ordered in at least six parishes. In New Orleans and six other parishes, voluntary evacuations were recommended. Evacuation orders often lacked specificity with orders issued for evacuation of flood-prone areas. Although the evacuation plan for the area had recently been updated with improvements intended to reduce congestion, a

universal observation by emergency management officials surveyed in a post-incident transportation analysis was that heavy traffic and congestion were problems during the evacuation (FEMA, 2005b). Intense traffic congestion resulted in some people taking up to 36 hours to evacuate the city. Four elderly persons died during the evacuation of New Orleans.

Prior to Hurricane Ivan, there were limited plans in place to identify or evacuate special needs individuals who did not reside in special needs facilities.

3.4 Chemical Fire, Romulus MI (2005)

Overview:

- Approximately 3,000 persons evacuated.
- There were initial concerns of terrorism but this was quickly ruled out.
- There was a small shadow evacuation, but this did not affect the evacuation.
- Residents outside of the evacuation area were asked to shelter in place.
- Ambulances were used to evacuate a few special needs residents.
- Police and fire department personnel drove through some areas to verify that people had evacuated.
- Two high schools were used as shelters, although few people reported to the shelters.

On August 9, 2005, a hazardous waste tank exploded initiating a chemical fire in Romulus, Michigan (HHS, 2006). A voluntary evacuation of approximately 3,000 people within 0.8 km (0.5 miles) of the plant was ordered. The population immediately outside of the evacuation area, were asked to shelter in place, close windows and doors, and turn off air conditioners. The fire department utilized a public address system, the media, and some door-to-door notification to inform the public to evacuate. Officials had only issued an order to evacuate a 0.8 km (0.5 mile) radius; however, the media announced a 1.6 km (1 mile) radius for the evacuation area. Because the area was larger and the additional evacuees were not affecting the response, the fire department did not attempt to correct the error. Those who evacuated were allowed to return home after two days. In the research of this incident, emergency management confirmed that there was an initial concern that this accident may have been initiated by terrorists, but the concern was quickly alleviated.

3.5 Hurricane Katrina (2005)

Overview:

- Approximately 2 million people evacuated.
- Only one death was attributed to the evacuation (Times - Picayune, 2005).
- The evacuation was considered successful for those who wanted to and could leave.
- Some parishes, such as Plaquemines, had very high evacuation rates.
- Evacuations in Louisiana and Mississippi were generally staged.
- More than 1,800 people died during and after Hurricane Katrina.
- Approximately three quarters of those who died were elderly.
- More than 75,000 people sheltered in over 240 facilities throughout the region.
- The New Orleans Superdome was officially opened as a shelter of last resort.

- The New Orleans Convention Center was not officially opened as a shelter, but became an ad hoc shelter as residents and tourists searched for high ground.
- Over 6,000 prison inmates were evacuated after the hurricane.
- The DHS National Response Plan (NRP) was implemented for the first time.
- The EPZs for Waterford, River Bend, and Grand Gulf NPPs were within the area affected by the hazard.
- Elements of emergency response planning for the Waterford NPP were utilized to support the evacuation in the vicinity of the plant.

Hurricane Katrina first made landfall near Buras, Louisiana on August 29, 2005 as a Category 3 hurricane. At landfall in Louisiana, wind speeds of up to 200 km/hr (125 miles/hr) were reported (NHC, 2005), and the storm was approximately 645 km (400 miles) wide. The impact of the hurricane was devastating in many ways, including the flooding of New Orleans, the storm surge destruction along the eastern Louisiana, Mississippi and Alabama coastlines, and the destruction from hurricane force winds that continued inland for many miles. The post-landfall response for this incident was larger than any local, State, or Federal agency had planned. With local, county and State resources overwhelmed and unable to adequately respond, the DHS NRP was invoked for the first time on August 30, 2005 (DHS, 2004).

In the days preceding the hurricane, approximately 2 million people evacuated the region. The pre-landfall evacuation of New Orleans during this time period was widely viewed as a success, and data showed that more people were able to leave the city in a shorter time than had been thought possible (Wolshon, 2006). Many local Emergency Operations Managers or parish presidents ordered mandatory evacuations early beginning August 27, 2005. Several parishes in Louisiana and counties in Mississippi and Alabama coordinated efforts to facilitate a staged evacuation. The public was notified primarily through television and radio broadcasts. Evacuation notices were provided by local and State authorities, and some door-to-door notification, usually in high risk areas, was conducted. The evacuations were staged and pamphlets were handed out to inform residents of the order in which they would evacuate when the evacuation was implemented. Residents living in low lying areas, mobile homes, and along waterways were encouraged to evacuate early. To facilitate massive traffic volumes, contraflow lanes in Louisiana and Mississippi were opened early in the evacuation and traffic management was coordinated among the two States.

Staged evacuations are frequently conducted in hurricane areas to move people nearest the coastline away from the hazard first and help reduce traffic congestion. The mayor of New Orleans delayed the issuance of a mandatory evacuation order until August 28, 2005. This was the first ever mandatory evacuation order for the City of New Orleans. Beginning in the afternoon of August 28, 2005, New Orleans city buses were used to transport residents to the Superdome (LOHSEP, 2006). The Superdome was established as a shelter of last resort.

In Mississippi, Alabama, and eastern Louisiana the hurricane effects were completely different with most damage caused by a storm surge and hurricane force winds. In Mississippi, coastal communities such as Bay St. Louis, Waveland, Pass Christian, Gulfport and Biloxi were devastated when a storm surge of more than 10 meters (up to 35 feet) inundated the area.

In Mississippi, well organized efforts to move special needs individuals to shelters were

implemented. In Gulfport, Mississippi, arrangements were in place to use school buses and ambulances to transport special needs individuals to shelter facilities. The list of special needs individuals in this area had not been well developed resulting in residents calling for assistance during the evacuation. There were no reports of individuals who wanted to leave but could not; however, local responders identified the need for a more complete list as an area for improvement.

In New Orleans, after the hurricane passed, devastation was caused by flooding when the levees and pump systems failed. Approximately 80 percent of the city was flooded with water depths of more than 5 meters (almost 20 feet) in many areas. The flooding caused thousands of individuals, who had not been evacuated in response to the hurricane, to leave their homes and seek shelter. Many of these individuals went to the Superdome or Convention Center. As these facilities became overcrowded, evacuees were turned away and forced to seek shelter elsewhere, although alternative shelters were virtually non-existent. Problems were compounded by the lack of supplies for several days.

A massive search and rescue operation ensued to rescue those stranded in their homes due to the flooding. This included rescuing residents of nursing homes, hospitals, prisons, and other facilities. The flooding severely affected the response activities, requiring use of helicopters and boats for most of the effort. The heat and lack of communications created significant challenges during the rescue effort. More than 1,400 people lost their lives in Louisiana (LDHH, 2006). Approximately 70 percent of all deaths were people older than 60 years of age (United States, 2006b). Another 231 people died in Mississippi, bringing the total to almost 1,800 with several hundred reported missing (United States, 2006a).

Hurricane Katrina was the first large scale disaster to fully test the NRP and revealed that Federal agencies, including DHS, had varying degrees of unfamiliarity with their roles and responsibilities under the NRP and National Incident Management System (NIMS) (United States, 2006a). During the response to Hurricane Katrina, critical elements of the NRP were executed ineffectively, late, or not at all. These critical elements included such actions as declaration of an Incident of National Significance, convening of an Interagency Incident Management Group, and designation of the Principal Federal Official (United States, 2006a).

3.6 Hurricane Rita (2005)

Overview:

- Aggressive communication and fear tactics prompted more than 3 million people to evacuate from the Houston area and Texas coast (HRO, 2006).
- Approximately 400,000 evacuees from Hurricane Katrina had relocated to the Houston region and were included in the Hurricane Rita evacuation.
- Over 100 fatalities were directly attributed to the evacuation (Henk, 2007).
- The evacuation was generally staged with Galveston, Corpus Christie and Jefferson County evacuating prior to Houston.
- The evacuation of Galveston was very successful.
- Thousands of special needs individuals were evacuated out of the region.
- Evacuation travel times from 12 to 36 hours were not uncommon.

- Contraflow lanes were unplanned and established too late to have much benefit.
- Regional shelters were quickly at full capacity.
- The EPZs for the South Texas Project, River Bend, and Waterford NPPs were within the area affected by the hazard.
- Elements of the Matagorda County emergency planning for the South Texas Project NPP were used to support the emergency response for the county.

On September 24, 2005 Hurricane Rita made landfall near Port Arthur, Texas. In the days preceding landfall, residents along the Texas Gulf Coast began preparations for an evacuation that included both Texas residents and evacuees of Hurricane Katrina who had relocated to the area. In an effort to avoid the criticism seen as a result of the late mandatory evacuation of New Orleans for Hurricane Katrina, the local mayors of Galveston, Houston and other communities ordered mandatory evacuations early. It was evident that Houston officials were aware of the delay in ordering the evacuation of New Orleans only a few weeks earlier and wanted to be sure that evacuation orders for Hurricane Rita were issued with ample time to comply. In order to persuade residents to evacuate, authorities frequently referenced the recent events in New Orleans (Litman, 2006) and warned residents not to place themselves in a similar situation. In the Houston area, officials requested people evacuate if they lived in areas that had previously flooded. These broad based instructions and fear tactics resulted in a much larger number of individuals evacuating than actually needed to evacuate. In their haste to order the region to evacuate, officials did not consider the impact of so many individuals on the roadway system. The resulting traffic congestion and poorly coordinated transportation logistics created a hazard in itself.

The fear over what had occurred in New Orleans and Mississippi three weeks earlier coupled with the high influx of evacuees from Hurricane Katrina prompted more than 3 million people to evacuate the Houston area and the Texas coast (HRO, 2006). An estimated two-thirds of the evacuees did not need to evacuate (TTR, 2006) but did so because of poor communication, fear tactics, and what researchers have termed as the “Katrina Effect.” The severe traffic congestion and lengthy evacuation times resulted in fuel shortages for many evacuees. Temperatures in the Houston area neared 100 degrees, aggravating pre-existing health conditions of some evacuees and causing dehydration and heat stress in others. As a result, approximately 130 fatalities were reported with at least 106 of these related to the evacuation (Henk, 2007). Only three deaths in Texas were identified as direct deaths from the hurricane. Direct deaths indicate those caused by the direct effects of the winds, flooding, tornadoes, storm surge or oceanic effects.

An example of applied training was evident during the evacuation of the University of Texas Medical Branch in Galveston, Texas. Due to discussions in pre-planning activities, the hospital was able to be completely evacuated in 12-hours using ambulances, helicopters, planes, and buses. The agencies responsible for the evacuation made quick and effective decisions directly in-line with training and from experience.

3.7 Hurricane Wilma (2005)

Overview:

- As many as 300,000 people evacuated.
- Hurricane Wilma was the third large hurricane to hit the United States in a period of 6 weeks.
- Evacuations were generally staged.
- In some areas, approximately 80% of those ordered to evacuate did not leave.
- Hurricane Wilma caused the largest electrical disruption ever reported in Florida.
- More than 100 shelters were opened to the public.
- Approximately 37,000 people, including about 2,100 special needs individuals, reported to shelter facilities.
- Monroe and Miami Dade counties provided city and school buses for those who needed transportation.
- The EPZs for Turkey Point and St. Lucie NPPs were within the area affected by the hazard.

Hurricane Wilma was the twelfth hurricane and the third Category 5 hurricane of the 2005 Atlantic hurricane season. Hurricane Wilma was the most intense hurricane of the season and caused considerable damage in the Yucatan Peninsula. The hurricane lessened in strength and made landfall in southern Florida as a Category 3 hurricane on October 24, 2005. Evacuations in anticipation of Hurricane Wilma began on October 19, 2005 when Florida officials ordered tourists out of southern Florida and ordered schools closed to allow families to prepare and evacuate from the storm. Although Florida residents were strongly urged to evacuate the area, media reports indicate that in some areas, as many as 80% of residents under mandatory evacuation orders did not evacuate. In other areas, the compliance rate was more consistent with other hurricanes. The low compliance to evacuation orders in areas of Florida is not uncommon and can be attributed to a variety of factors. In Florida there are better building codes and some people believe their homes will withstand hurricane winds (USACE, 1999). Additionally, the routineness of the hazard and ambivalence that some long time Floridians have come to develop with respect to hurricane preparedness contribute to a low compliance rate. Maybe most importantly for this incident, Hurricane Wilma was a very slow moving storm, and many residents were not sure of the direction or convinced that they would be affected.

In Monroe County, Florida providing transportation to residents is an important factor in an evacuation. Many residents live on boats and do not have vehicles for transportation. There is one highway in and out of Monroe County, and residents requiring a ride can wait on the side of the road for bus transportation. Individuals with special needs can register to be picked up or can call during the evacuation and request to be picked up. Generally, this population group is evacuated first.

Shelters were available to residents prior to and post-landfall of Hurricane Wilma with over 120 shelters open and available to residents. Over 37,000 evacuees and more than 2,100 special needs evacuees registered at shelters (Florida Emergency Management, 2005).

3.8 New England Flooding (2006)

Overview:

- Over 7,000 people evacuated.
- Evacuations were staged based on flood conditions.
- Over 600 roadways were flooded out, but this did not adversely affect the evacuation.
- Shelters were established in all affected areas.
- Approximately 10 percent of evacuees used shelter facilities.
- Several special needs facilities were evacuated.
- The EPZs for Seabrook and Pilgrim NPPs were within the area affected by the hazard.

From May 11 through May 23, 2006, record amounts of rain fell over Massachusetts, New Hampshire, and parts of southern Maine causing thousands of residents to evacuate. Flooding that occurred as a result of the heavy rainfall was reported as the worst since the New England Hurricane of 1938 (CBS, 2006). Evacuations often occurred in pockets throughout the region on an as needed basis depending on where they were located in the flood plain and projected weather forecasts. Hundreds of roads were closed in Massachusetts due to flooding, and over 600 roads were closed in New Hampshire. Having recently experienced extensive flooding in October, 2005, the public readily cooperated with evacuation requests in 2006.

Several nursing homes and other special needs facilities were evacuated. In Lawrence, Massachusetts, a large nursing home with approximately 243 residents was evacuated in 8 hours. Due to the fast rising flood, some evacuees had to be floated out of the facility in oversized laundry bins (Catholic Health World, 2006).

3.9 Chemical Fire in Apex, North Carolina (2006)

Overview:

- Initial instructions were to shelter in place.
- Approximately 17,000 persons evacuated.
- The evacuation was staged.
- One nursing home with approximately 100 individuals was evacuated.
- Raleigh city buses were used to transport those that needed transportation (very few people used this mode of transportation).
- A shadow evacuation of more than 30,000 people was observed.
- The chemical facility and the evacuated area are located within the Shearon Harris NPP emergency planning zone.
- Elements of the Shearon Harris NPP emergency plan were utilized to support the evacuation efforts.

On October 5, 2006 a fire at a hazardous waste facility in Apex, North Carolina caused the evacuation of over 17,000 people. The evacuation was staged, and very clear geographical demarcation areas were communicated to the public. Initial instructions to the public were to shelter in place followed by an evacuation order issued a short time later. Some residents who lived close to the facility and could see flames and hear explosions evacuated spontaneously

before being told to do so. Emergency management personnel estimated that a large shadow evacuation contributed more than 30,000 additional people to the evacuation. Emergency management officials stated that only a small number of people chose not to evacuate the area.

During the incident, the Apex Police Department and 911 Center were in the plume exposure pathway and were evacuated. Approximately 15 police cars in the parking lot could not be utilized for the evacuation because they were within the area contaminated by chemicals carried in the plume. Some police officers called to duty had no vehicle or communication resources to use in the response. Through the resourcefulness of the police department and emergency response agency, this did not adversely affect the evacuation.

One nursing home with approximately 100 residents was evacuated without incident in about 3.5 hours. To accommodate transit dependent individuals, Raleigh city buses were used to evacuate those who needed transportation. This activity was implemented in an ad hoc manner and was conducted successfully, although few people utilized the resource.

3.10 Hawaii Earthquake (2006)

Overview:

- Approximately 3,000 people evacuated.
- Evacuations were primarily from hotels and hospitals.
- The evacuation was conducted in a matter of hours.
- Shelters were established quickly and used effectively.
- Some special needs individuals were airlifted to Honolulu.

On October 15, 2006, an earthquake occurred near the big island of Hawaii. The earthquake caused an evacuation of about 3,000 people from Kona and South Kona. The majority of the evacuees were from hotels and a hospital damaged by the earthquakes. Hotel evacuees were taken to a local gymnasium until alternate accommodations could be found. Kona Community Hospital was evacuated and required a few patients be flown to Honolulu. Though there was no threat of a tsunami from the quake, police implemented tsunami evacuation plans to keep traffic moving on the roadways. Those who did not have to drive were encouraged to stay at home during the day. The Hawaii earthquake is of interest in this research because the evacuees were primarily from special facilities and hotels. Although most of the evacuees were tourists, there were no reports of individuals not understanding or not following the evacuation orders.

The evacuated hotels and resorts had developed their own emergency response plans which included evacuation plans. From discussions with hotel personnel, the guests were notified to evacuate via the public address system which still worked after the earthquake. It only took a few minutes to evacuate one hotel, and staff did go through each room to verify that residents had evacuated.

3.11 California Fires (2007)

Overview:

- Approximately 900,000 people evacuated.
- Evacuations were initially staged but became more widespread as the fire quickly encroached upon areas.
- Shelter in place was implemented in select areas.
- Twelve deaths were identified, and two of these were elderly individuals being evacuated.
- Communications were significantly improved over the 2003 fires.
- QualComm Stadium was used as a mega-care center for residents, special needs and pets.
- Latch key kids were evacuated in San Bernardino.
- Multiple special needs facilities and special needs individuals not residing in facilities were evacuated.
- The EPZ for San Onofre NPP was within the area affected by the hazard.

Between October 20 and November 9, 2007 a series of 23 wildfires burned across areas of southern California from Los Angeles and San Bernardino Counties in the north down to San Diego and Imperial Counties near the United States and Mexico border in the south. The wildfires precipitated the largest evacuation in California's history, with some estimates suggesting nearly a million people evacuated (LA Times, 2007). The fires burned more than 500,000 acres and consumed over 3,200 structures, including more than 2,200 homes (OES, 2007a). In addition to the destruction of property, the wildfires caused the death of 12 people, identified at the time of this research, and the injury of an additional 139 people (OES, 2007a), more than 60 of whom were firefighters.

Although similar in many respects to evacuations for other hazards, wildfire evacuations, are somewhat different because they are very fluid and based on the conditions of the event. The 2007 wildfires, as is common, had no set origin and pattern of movement. The plans for wildfires basically involve a fire department's order of where and when to evacuate, and the corresponding law enforcement agency determining how best to carry out the evacuation. Some areas, like the mountainous regions of San Bernardino County, do have designated emergency routes inasmuch as they are the only routes out of the area.

Because fire conditions warrant the priority movement of some areas prior to others, phased evacuations have been affected by ordering certain areas to evacuate earlier. Emergency response personnel stated that using tools like the AlertSanDiego system to target earlier calls to the most threatened zones first were helpful. Although most evacuations started as staged, they were quickly overcome by the size and speed of the fire and became more general, large area evacuations.

3.12 Emergency Planning Around Nuclear Power Plants

In eight of the eleven incidents studied, the hazard encroached upon one or more nuclear power plant EPZs. These eight incidents covered wide areas and affected 14 EPZs. Discussions with emergency response personnel confirmed that response to many of these incidents benefitted from the use of emergency planning elements developed for the EPZs.

During the field investigations, the emergency response personnel frequently cited the preparedness and training activities conducted for the NPP as being beneficial in preparation for response to the hazard. For the South Texas Project NPP in Matagorda County Texas, the emergency management department implemented some of the emergency response plan elements developed for the NPP and attributed some of their success during Hurricane Rita to the response exercises conducted for the NPP. In St. Charles Parish, Louisiana, some of the off-site emergency response plan elements for the Waterford 3 NPP were also used to support the evacuation, including the siren system, which was used as a form of notification for Hurricane Katrina. In Apex, North Carolina, the emergency response agency is within the EPZ for Shearon Harris NPP, and their training was also instrumental in the successful evacuation for the Apex fire. For the hurricanes that affected Florida, emergency response personnel stated that the EPZ evacuation routes are commonly the same for hurricanes. Emergency planning elements developed for the EPZs around NPPs were used to support these evacuations and proved to be beneficial.

3.13 Case Study Summary

The eleven incidents researched for this study cover a wide range of experience in emergency response and evacuations. Some of the common observations from these case studies include:

- Most of the evacuations were conducted in a staged manner.
- Special needs institutions were evacuated in most of the emergencies.
- Special needs individuals were evacuated in most of the emergencies.
- Shelters were used to support all of the evacuations.
- Most incidents included shadow evacuations.
- Emergency planning developed for EPZs was utilized and benefitted the response in eight of the eleven incidents.

In all of the incidents researched, there were elements of emergency planning and implementation that worked extremely well. It was evident in the case studies that implementation of lessons learned from previous evacuations improves subsequent response, and integrating regional resources in evacuation planning also improved the response.

4.0 Analysis of Incident Response Elements

The analysis of incident response elements included a comparison of the emergency response plans for each incident with the implementation of these plans as described in the case studies. As stated earlier, the 2007 California Fires were added to the scope of this project after the ratings had been completed and are not included in the assessments in this section. For each of the ten evacuations rated, local and / or emergency response plans were reviewed to provide a basis for the comparison. Emergency response plans were reviewed as the upper tier documents that establish responsibilities, authorities, and planning. Detail for conducting response activities is found in implementing procedures. Implementing procedures are typically developed by each of the agencies that have responsibilities under the emergency response plan. During field investigations, emergency response personnel were asked about implementing procedures, but a detailed review of these procedures was not practical and not within the scope of this study. For this study, five hurricanes, two technological hazards, one wildfire, one earthquake, and one flood were assessed. The diversity of these incidents presents a challenge when comparing common elements of emergency response but also provides the opportunity to learn from different types of responses. Due to the number of municipalities affected in these large scale incidents, many emergency response plans were obtained and reviewed, but not all local plans were included in the review.

The purpose of this incident assessment was to review areas of emergency preparedness and response to identify insights and lessons learned for the NRC and / or FEMA NPP emergency preparedness program. To support this review, the following seven emergency response elements were determined to be of greatest interest in meeting the objectives of this study:

1. Training,
2. Public Education,
3. Communication with the Public,
4. Communication with Responders,
5. Evacuation,
6 Special Needs, and
7. Shelter Facilities.

Each of the above elements was evaluated and rated subjectively for planning and implementation. The following criteria were used in the assessment:

Planning: Was the plan comprehensive and broad enough to encompass the hazard encountered? Did the plan include descriptions of responsibilities and authorities? Did the plan include public education, training, chain of command, public notification and warning, communications, transportation routes and modes, special needs individuals and facilities, and sheltering? Did the plan include coordination with other jurisdictions?

Implementation: Were the elements of the emergency response plan implemented according to plan? Were the pre-incident elements conducted, such as public education and responder training? Was the chain of command followed? Were timely decisions made? Were plans coordinated with other

jurisdictions, if applicable?

The rating scale used five levels including ineffective, marginally effective, effective, very effective and excellent. This rating scale is similar to the rating scale used in the "Catastrophic Hurricane Evacuation Plan Evaluation" (DOT, 2006). The ratings are applied to the seven elements of interest and should not be considered comprehensive ratings for any incident. In establishing the ratings, an attempt was made to not allow the effectiveness of one incident to disproportionately affect the rating for the set of evacuations analyzed. Finally, it is noted that only ten incidents were assessed for this project. Although these ten incidents were high profile large scale evacuations, they may not be fully representative of a larger set; thus, more quantitative statistical analyses are not possible.

4.1 Planning

For the assessment of planning elements, emergency response plans at the State and / or local level were reviewed for each incident, and where possible the plans that were in place at the time of the incident were reviewed. It was evident from this review that emergency response planning was generally well documented in identifying objectives and the resources required to meet response needs, although there are areas for improvement as identified below. This is consistent with the Nationwide Plan Review (DHS, 2006a and 2006b), which found that State and urban area plans are generally consistent with Federal planning guidelines. It is also consistent with the Catastrophic Hurricane Evacuation Plan evaluation, which found that planning was very effective (DOT, 2006).

4.1.1 Training

Training as addressed in emergency response planning was rated as **very effective**. Training is an essential element of emergency response planning and was included in all of the emergency response plans reviewed. Training is a broad activity that encompasses items such as continuing education, on-line training courses, and formal classroom and field training. Training also includes table top exercises, drills, and full scale exercises. In general, it was found through review of documentation and discussions with emergency response personnel that training of emergency response personnel is routine, thorough and practical for emergency responders. Training was addressed in the emergency response plans, details were provided on types and frequency of training, and structured programs were frequently identified. Emergency response personnel confirmed that the training generally follows the established plans and procedures. Comprehensive training is not always available to smaller jurisdictions and is not as formalized for select hazards, such as flooding or wildfires.

The State and local plans reviewed contain provisions for training that are adequate for most emergency response needs. The plans reviewed included discussion of the need for training and the types of training to be conducted, with some plans including detailed training requirements. In discussions with emergency responders, the overwhelming response was that they receive training that is directly applicable to incident response. The size and extent of training was often dependent upon the size of the community and anticipated hazards, as well as available funding, staffing, and scheduling constraints.

An important element of training is the conduct of exercises. Most plans called for at least one large scale exercise each year. In Texas, traffic management tests were conducted in five hurricane evacuation regions in June, 2005 (HRO, 2006). Cross jurisdictional exercises have not been frequently conducted, although these are becoming more common. The importance of cross jurisdictional exercises is receiving more attention, and it appears the trend is to develop response plans on a more regional basis with consideration for both the receiving jurisdictions and the evacuating jurisdictions.

Emergency response personnel and management understand the benefits of training and dedicate substantial portions of their time to training. There was a commitment among responsible authorities to ensure that adequate training is planned, available and provided. New topics are routinely added to the training regimen in response to lessons learned. At the 2006 National Hurricane Conference, for example, training was offered in the areas of rapid needs assessments and emergency planning and special needs populations. Training that covers traffic management plan development and traffic control for emergency response is now also available. The need for such training has become evident based on the response to Hurricane Katrina and other incidents.

The training opportunities for emergency responders are abundant and continue to develop. These same training opportunities are available to emergency response agencies that serve EPZs. Emergency responders in the vicinity of EPZs have additional opportunities for training specific to the response conditions of a potential NPP accident.

4.1.2 Public Education

Public education as addressed in emergency response planning was rated as **effective**. Most of the plans reviewed referenced public outreach efforts of some kind ranging from distributing information at libraries to mailing brochures to all residents. Some plans included use of televised emergency awareness messages. In the areas where there are annual hazards such as the Gulf Coast States, fire and flood prone areas, education programs are frequently well defined and include public awareness presentations to local civic groups, schools and businesses. At least one plan included preparing special information to target selected special needs population groups.

Seasonal hazards such as hurricanes, floods and wildfires differ in educational awareness needs from technological hazards, such as chemical fires. The Atlantic and Gulf Coast States are subjected to a hurricane season from June 1 through November 30 each year and typically have educational awareness programs to inform the public before and during the season. The start of the hazard season is often discussed in newspapers and broadcast through local and national news media. Public education efforts to inform the public of potential hazards on a routine basis can be extensive in hurricane regions and in wildfire and flood prone areas. Brochures and other mailings are frequently distributed to all area residents. Public awareness campaigns are common in some coastal cities to inform the public and improve the registration of special needs individuals. In some areas, information on local hazards is provided annually to school children. Lastly, most State and local emergency response agencies have websites that provide information on the hazards in the area, protective actions, and requirements for the public in the event that protective actions are recommended.

Technological hazards may have no warning and frequently occur in areas where residents may be unaware of the potential hazards. Local Emergency Planning Committees (LEPCs) are established to provide a forum for emergency management agencies, responders, industry and the public to work together to understand the chemical hazards within their communities and to develop emergency plans in case of accidental releases. LEPCs develop websites and conduct public meetings making information available to the interested public. In large scale technological evacuations, lack of public education has not been an issue, because the emergency response for a technological hazard is usually very prescriptive (NRC, 2005a). For these types of incidents, the public may not need much, if any, information on their responsibilities and will be informed by authorities and provided specific direction as the incident unfolds.

In researching public education, there were documented success stories with many incidents, and there were issues identified as well. In the Blue Ribbon Report on the California wildfires, it was stated that the lack of a comprehensive public education program has resulted in a public that is uninformed or apathetic about wildfire risk reduction (Campbell, 2004). However, in the same report, the pre-incident awareness activities of the Mountain Area Safety Taskforce in San Bernardino California was credited with facilitating the successful evacuations from mountain communities.

Although there are large amounts of information available to the public, the incidents assessed indicate that the public was not always aware of their role in the emergency. Only one emergency response plan identified the need to develop special information to target special needs population groups. In reviewing older emergency response plans as well as newer plans, it appears that there is a trend to increasing efforts in public awareness and utilizing a larger variety of media to convey this information. From a general perspective, the DHS Nationwide Plan Review (DHS, 2006b) identified that most of the participants in the plan had developed comprehensive public outreach and education programs, but in general, public education was not sufficiently addressed. The Nationwide Plan Review identified that specific information and procedures to increase the public's ability to prepare for and respond to an incident were not in place. Public education within EPZs generally includes distribution of information packets, which may be brochures, calendars, or other forms of information, at least annually. Information is made available to the public, as required in 10 CFR 50.47(b)(7), on how they will be notified and what actions they should take. It was evident during this research that differences in planning among counties or parishes was frequently dependent on the local commitment of a specific emergency management agency. Such commitment appeared to be fostered by the frequency in which organizations interact with one another during emergencies. The routing training and drills for NPP emergency response planning also fosters a similar relationship among response agencies.

4.1.3 Communications

4.1.3.1 Communications with the Public

Communication with the public was rated **effective** and includes communication before and during an incident. Communication protocols are established to inform residents of a hazard, warn them of potential response actions, and advise them when to take protective action.

Notification and warning methods were identified in the emergency response plans. The types of notification and alert systems identified included use of the Emergency Alert System (EAS), Reverse 911® type systems, route alerting, sirens, television broadcasts, cable television scroll, and websites. Route alerting is generally defined as emergency responders driving through neighborhoods informing the residents via a public address system from their vehicle. However, some areas also use the term route alerting synonymous with door-to-door notification. For hurricane incidents, newspapers and distribution of paper notices are frequently used because of the time available prior to predicted landfall. The selection of public notification methods depends upon the timing and extent of the incident. Some plans stated that information on evacuation routes and shelters would be conveyed over the EAS, and some plans included prepared EAS messages.

All plans identified the need for communication with the public during an evacuation. However, only a few plans described potential methods or resources necessary to communicate with the public during these stages of the incident. Many plans do not address communicating details on available transportation modes, such as busing, access to transportation, and requirements for individuals using these modes, such as restrictions on what evacuees may carry with them when traveling on buses (DOT, 2006). While en route during a large scale evacuation, it is necessary to inform the evacuees of the direction of travel, road conditions, traffic conditions, and other logistical travel needs such as whether gas or rest facilities are available. Common systems to provide information to evacuees while they are en route include Highway Advisory Radios, dynamic message signs, public radio station announcements, and traveler information phone numbers. All of the plans reviewed included one or more of these communication methods.

Most States have implemented telephone traveler information systems to provide information on roadway and evacuation conditions. States are increasingly using the Federal Communication Commission established telephone numbers (211, 311, and 511) to provide general information to the public and evacuees. Although not implemented in all States, these phone numbers, which are similar to the 911 emergency phone number, are dedicated for non-emergency assistance or traffic related information. The public may call these numbers and speak to an individual to ask questions or may receive a recording on the status of events. A practical problem with providing current traffic information to evacuees is that there are fewer traffic data acquisition systems along routes outside of urban areas, and thus congestion may become quite large before the traffic management center is aware of the condition. This can result in inaccurate information provided to the evacuees. Telephone systems can also become overloaded in an emergency and frequently the public is asked to refrain from using the system.

The need to convey information in multiple languages was identified in about half of the plans reviewed, but there was not a consistent approach to addressing this need. The Nationwide Plan Review (DHS, 2006b) also identified the inability to provide messages to the public in multiple languages as a widespread weakness.

Communication with the public prior to and during an evacuation is important to facilitate an effective public response, but consideration must be given to the likelihood of the hazard impacting the area. It is essential that emergency response planning address the need for communication of frequent, concise, and unambiguous information to the public. None of the

plans reviewed included communicating with the public outside of the declared evacuation area to inform them of expectations. This is an area where enhancements may be beneficial in reducing unnecessary evacuations and reducing traffic congestion. Informing the public in non-affected areas at early stages of the incident may help reduce shadow evacuations and free up much needed capacity on the roadway network. Communication with the public residing in EPZs would begin with sirens or tone alert radios followed by EAS messages. The communication systems are routinely tested and exercised.

4.1.3.2 Communications with Emergency Responders

Communication among emergency responders was rated **very effective**. An effective response requires communication between response agencies, field incident command centers, and emergency operations centers. All of the emergency response plans reviewed identified requirements for communications among emergency response personnel. All of the plans identified the communication resources and discussed a chain of command. Most plans identified, at least to some extent, the types of systems to be used and how these systems are coordinated. As communities improve their communication infrastructure, the emergency response plans are being updated to integrate these improvements.

In the last few years, many municipalities and agencies have obtained 800 MHZ radio systems. These systems have become a primary resource for communications, but they can still be overwhelmed when the number of agencies and personnel participating in the response is greater than the number for which the system was designed. Redundant and back up means of communications such as cell phones, telephones, satellite phones, two-way radios, and amateur radios are routinely identified in the plans to augment communication among responders. For large scale incidents which require such a variety of communications, an emphasis on interoperability is necessary. Only a few plans identified interoperability as a necessary function of the communications system, however, the planning of multiple communication methods mitigates some interoperability issues.

4.1.4 Evacuation

Evacuation as addressed in emergency response planning was rated overall as **effective**. Evacuation planning requires consideration of the areas to be evacuated, the means to evacuate the public, and the population groups to be evacuated. All of the plans reviewed established a chain of command and identified the authorities responsible for declaring an evacuation.

The emergency response plans typically included information on techniques used to facilitate better movement of vehicles during an evacuation, such as more extensive placement of traffic control officers, use of dynamic message signs to communicate congestion status, rest areas, gas stations etc., pre-placement of tow trucks and service vehicles, and use of contraflow. At least one plan reviewed included all of these strategies. The Federal Highway Administration (FHWA) suggests that some strategies to improve the impacts of traffic influencing events should also include providing travelers with information on travel conditions and improved management of construction zones (FHWA, 2004).

Most of the emergency response plans did not discuss advanced traffic management strategies. Typically for technological hazards, the evacuations were generally ad hoc in nature, meaning that evacuation routes were determined in real time and usually influenced by wind direction. Planning should consider that impacts to the transportation network in large scale evacuations often occur far away from the source (Wolshon, 2006). Some States such as Louisiana, integrate the expertise of transportation agencies with emergency management and public safety to support improved traffic control by bringing the planners and implementation resources together. It was observed that when enhanced traffic management planning for large population areas was integrated among agencies, the evacuation was more efficient. Law enforcement was typically identified as responsible for implementing the evacuation. Some plans stated that evacuation routes would be identified in the EAS messages, while others included the actual evacuation routes. Some plans included a description of the means to evacuate transit dependent individuals, and a few plans included information on individuals with special needs.

The transit dependent population, for this study, is identified in NUREG-0654/FEMA-REP-1, Rev. 1, Appendix 4 as permanent residents that do not have access to an automobile. This population group differs from special needs in that aside from not having an automobile, the population group is assumed to be without need of other assistance. At least three plans stated that city buses would pick up individuals waiting along established bus routes. One plan included clearance times required for hurricane evacuations.

Evacuation of the transit dependent public requires additional planning and this was included in most plans. Busing was included in the planning for both Harris County and the City of Galveston and was implemented in Texas during Hurricane Rita. Likewise, busing was planned and successfully used in the evacuation for Hurricane Katrina in many parishes in Louisiana and in areas of Mississippi. Busing is also planned and very well organized in Florida. The City of New Orleans Comprehensive Emergency Management Plan (2005) stated that the city would utilize all available resources to evacuate threatened areas and that special arrangements would be made to evacuate persons unable to transport themselves. The plan further stated that approximately 100,000 citizens of New Orleans do not have means of personal transportation. Planning for the use of buses to support the evacuations appears to have been in place at the time of Hurricane Katrina but was not implemented at an appropriate level to support the needs of the public.

Louisiana has since developed a new plan to evacuate the transit dependent population from the New Orleans area. The new plan includes regional coordination with the Federal government to acquire the necessary buses from surrounding areas and States. The logistics of mobilizing buses from regional areas requires making a decision to mobilize more than 100 hours prior to landfall of a hurricane (Montz, 2007). Busing of people out of the area will begin 54 hours prior to the onset of tropical storm force winds. Pets are not allowed on the buses, but will be placed in animal crates and evacuated separately, not to the public shelters, but to locations provided by the Department of Agriculture (Montz, 2007). Implementation of this new approach will provide opportunities to learn whether such adjustments improve the evacuation response. This approach to busing is different than the planning for EPZs which provides that buses supporting an evacuation be identified and the time to mobilize and evacuate the residents that require public transportation be estimated (NRC, 1980).

4.1.5 Special Needs

In reviewing emergency response plans for this element, both special needs facilities as well as special needs individuals were assessed, and both were found lacking in sufficient detail in most plans. These two categories are reviewed separately because of the distinct differences. Special needs facilities are required to have their own evacuation plans while special needs individuals utilize public resources available during an evacuation. In reviewing the emergency response plans for these incidents, special needs facilities were identified in all plans and special needs individuals were identified in most plans. However, the means and methods for evacuating were not well described. For instance, the Americans with Disabilities Act of 1990 (ADA) was not referenced in any of the emergency response plans reviewed. The only specific mention of ADA related activities was during the 2007 California response to the fires where the Reverse 911® system had the capability and was used to call teletypewriter systems and telecommunication devices of deaf individuals and individuals with speaking impairments. There were instances noted of disabled individuals at shelters who needed to be carried to restroom facilities because shelters were not ADA compliant. The emphasis of emergency response planning is on the immediate safety of the public, as it must be. As local emergency preparedness and response programs develop, it was observed through discussions with emergency response personnel that existing Federal requirements, such as ADA, are being integrated to the extent practical, and where safety of the public is not compromised.

4.1.5.1 Special Needs Facilities

Special needs facilities as addressed in emergency response planning was rated **marginally effective**. Special needs facilities were evacuated in all but one of the evacuations researched in this study. Only the Romulus chemical fire evacuation did not require evacuation of a special facility. Most of the emergency response plans reviewed mentioned that special needs facilities are responsible for developing their own plans. At least one plan listed the special needs facilities in the area. None of the plans mentioned that the special needs facility evacuation plans should be reviewed or coordinated. None of the plans identified the potential need to support the evacuation of special facilities. One plan stated that special needs individuals are the responsibility of the facility.

Special facilities typically include hospitals, nursing homes, prisons, schools, and other facilities where additional time may be necessary to evacuate the public. These facilities usually develop their own evacuation plans and include provisions for transport of the residents. Special needs Medicaid and Medicare certified facilities are required under 42 CFR 483.75 to have detailed written plans and procedures to meet all potential emergencies and disasters. In developing their evacuation plans, special facilities face unique issues and must decide whether the risks of evacuating seriously ill and frail individuals are greater than the risk of not evacuating. Supporting the medical needs of some individuals is challenging making planning very important. Support during an evacuation may include such things as providing specialized transportation, medication, maintaining specialized medical equipment, or providing a medical attendant throughout the evacuation. The responsibility for evacuation planning may be that of the facility, but coordination among evacuation plans is necessary to assure resources will be available during a large scale evacuation.

The Florida Emergency Status System was identified at the 2007 Nursing Home Hurricane Summit as a promising planning practice (FHCA, 2007). The system is used to report and track health care facility status. The Georgia Division of Public Health is developing a system similar to the Florida system and will include data on evacuation transportation resources to help identify where resources may be over committed (FHCA, 2007). These improvements are based on lessons learned and indicate that States are beginning to recognize that special facilities require additional attention during planning. For emergency planning within EPZs, NUREG-0654, provides that special facilities be considered separately from the general population in order that details can be developed at the facility level.

4.1.5.2 Special Needs Individuals

Special needs individuals as addressed in emergency response planning was also rated **marginally effective**. Special needs individuals were addressed in most emergency response plans. A fundamental issue with special needs individuals is the lack of a consistent definition and the limited efforts to identify this population group prior to an incident. The definition used in this document is any individual who is unable to comply with an evacuation order without assistance from outside the home. The Catastrophic Hurricane Evacuation Plan Evaluation (DOT, 2006) included people who are elderly, those with disabilities or medical conditions, people with limited English proficiency, people with hearing and sight impairment, and people without access to private vehicles within the definition. The Nationwide Plan Review further adds to the definition individuals who are impoverished, chemically dependent, and those with emotional or mental disabilities (DHS, 2006b). The definition may be expanded further to include households where minor children are left alone at home (i.e., latch key kids). Although the basic definition of special needs covers all of the groups mentioned, emergency response personnel do not universally understand or consider all of these groups during planning or response. As an example, Hurricane Katrina made landfall near the end of the month when many lower-income families could not afford to evacuate. Traditionally this group was not considered special needs, but it is now recognized that additional planning is needed to support evacuation of this group.

Most of the plans reviewed identified the need to evacuate special needs individuals and included a fairly broad definition for this population group. None of the plans included as broad a definition as the above. Some plans provided information on how to identify special needs individuals prior to an emergency. Most of the emergency response plans reviewed for the Gulf Coast States included planning to pick up special needs individuals and take them to evacuation transfer points or special needs shelters. But only two of the plans included sufficient detail to actually implement, on a large scale, the evacuation of special needs individuals. The acuity level of nursing home residents influences the time to evacuate (FHCA, 2007), and this was not addressed in most of the emergency response plans.

Some counties and parishes implement plans to improve the evacuation of this population group including proactive efforts to locate and register individuals prior to a hazard event. An issue complicating registration is the reluctance of individuals to identify themselves as having special needs. In discussions with emergency planners and evacuees, some of the reasons for reluctance to register include:

- An assumption that someone (friend or family) will be willing to assist them;
- Sensitivity to their disability or their need for assistance;
- Concern about the security of the data; and
- Some individuals simply do not realize they have special needs.

The last bullet is particularly true of elderly individuals, who may believe they are able to evacuate, but some of whom should not attempt a multi-hour evacuation without assistance.

Proactive planning for special needs individuals is in place in many areas including Florida, Mississippi, and parts of Louisiana where special needs individuals are identified prior to an incident. Most of the response plans stated that registration cards were used to obtain information on special needs individuals and many emergency management departments allow registration via the web or telephone. In discussions with emergency response personnel, the response rate using registration cards alone can be low.

Plaquemines Parish, Louisiana, was identified as a proactive parish where the Office of Homeland Security and Emergency Preparedness recognizes the time consuming and safety sensitive issues of this population group and conducts very detailed planning. This includes using public health announcements combined with extensive outreach efforts to have people register with the parish. Home visits are made to each applicant and their condition and needs are verified. This has proven very effective in preparing for evacuations (St. Amant, 2007).

The planning for special needs individuals is now better recognized and is improving, but for those plans in place at the time of the incidents investigated herein, there were few that provided comprehensive planning for this population group. This population group needs advance planning to facilitate successful evacuation (FHWA, 2006). Planning should address early identification, communication, transportation, and sheltering needs for this broad population group.

4.1.6 Shelter Facilities

The assessment of shelter facilities as addressed in emergency response planning is rated **effective**. Shelter facilities were discussed in all of the emergency response plans reviewed. A review was conducted of types of shelters planned (e.g., general, special needs, last resort), under what conditions shelters were expected to be opened, and whether or not sufficient capacity was planned. There was a consistent lack of adequate planning for pets, limited planning for special needs individuals, and lack of adequate space for the very large evacuations.

Throughout the Gulf States, shelter facilities are used on a large scale. In Mississippi, shelters are planned for those who cannot evacuate and for those with special needs. In some areas, arrangements are in place with ambulance services to move individuals with special needs to shelter facilities. In Florida, shelter space has increased significantly in the last few years and more space is being added. Since Hurricane Andrew in 1992, Florida has had an aggressive program to increase shelter capacity to meet the anticipated demand and has significantly added to their inventory of shelters. In areas such as Monroe County, which is located at the southwestern tip of Florida and includes most of the Florida Keys, shelters are not planned to

open in the Keys for Category 3, 4, and 5 hurricanes and people must evacuate the Keys. Shelters are generally located in the Miami area for Keys residents.

Following Hurricane Georges, Louisiana State University conducted an assessment of approximately 200 shelters in Louisiana in the "Comprehensive Assessment of Hurricane Shelters: Lessons from Hurricane Georges" (Pine, 2003) and concluded that shelters opened for Hurricane Georges were considered by the local emergency management directors as the safest locations and best available sites. For Hurricane Georges, the Superdome was intended to be a special needs shelter only, but was later opened as a shelter of last resort.

In parishes throughout Louisiana, the shelter program is well planned. Most of the issues encountered with the Superdome and other shelters for Hurricane Katrina were due to the unexpected length of duration of the shelter period caused by the flooding of the city. The Superdome was not intended to house, feed and supply water to people for several days (Untied States, 2006a). Had the flooding not occurred, most individuals would have likely returned home the following day. For Hurricane Katrina, special needs shelters were planned and established in Lafayette, Alexandria, Baton Rouge, and Monroe and other areas; however, individuals usually needed to have their own travel arrangements to get to these shelters.

Sheltering evacuees is a well planned and routinely implemented protective action, but there are a few areas where improvement is needed. There remains a consistent lack of capacity for large scale evacuations. There continues to be a need for additional shelters for special needs individuals, and there is a need to improve the transport of individuals to shelters. Lastly, lack of capacity at pet friendly shelters continues to be observed. The issue, observed in many evacuations, is that people frequently refuse to evacuate if they can not take the family pets. Thus, the accommodation of pets is recognition that to fully protect the public and improve evacuation compliance, the entire family must be accommodated.

4.1.7 Planning Summary

Emergency response plans were reviewed for each of the incidents investigated. The review included State and / or local plans depending on the incident and availability of the response plans. Training and communications among emergency responders received very effective ratings. Special needs received a marginally effective rating, and the remaining elements all received effective ratings. Figure 4.1 on the following page provides a summary of the effectiveness of emergency response planning elements.

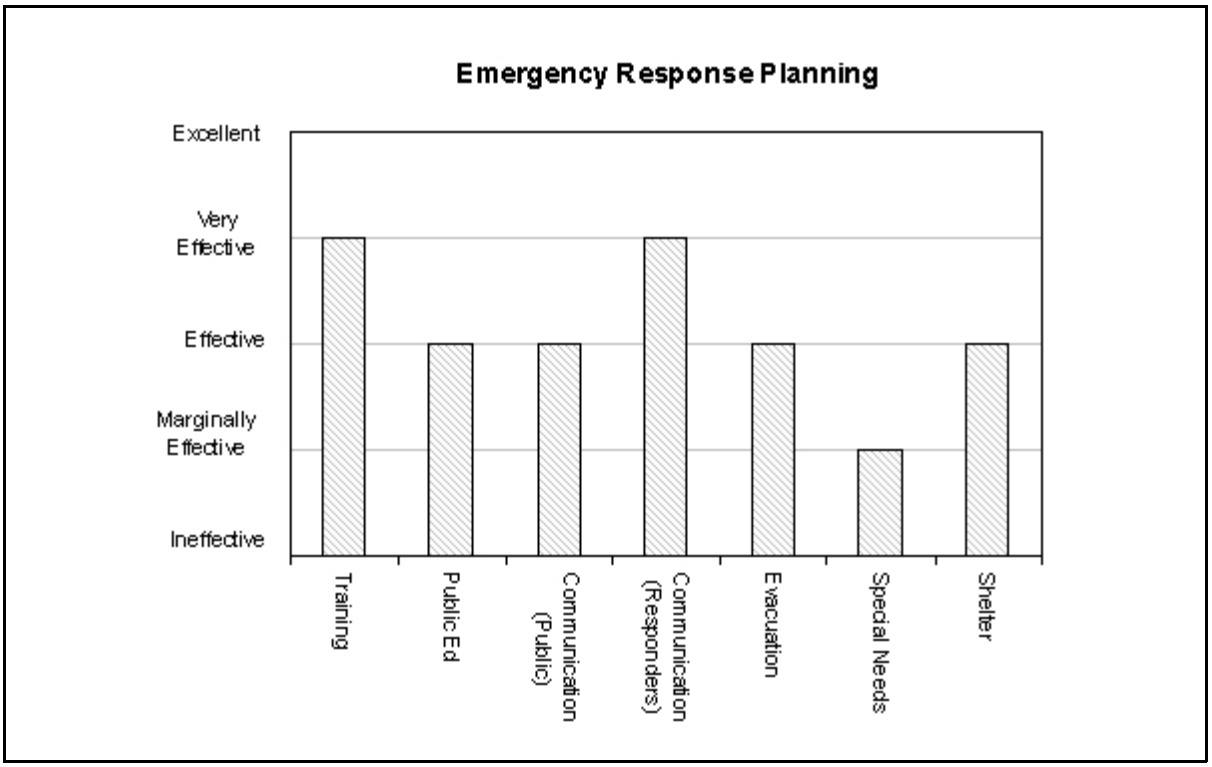

Figure 4.1. Relative Rating of Planning Elements

4.2 Implementation

While the rating for emergency response planning elements was based primarily on review of emergency response plans, the rating for implementation elements was based primarily on the information from interviews, research of each incident, and after action reports.

4.2.1 Training

Implementation of training for emergency response personnel and management was rated **very effective**. Training was found to be conducted on the emergency response plans and implementing procedures. Emergency response personnel generally agreed that training, which includes drills and exercises, provided the foundation for field decisions. Most emergency response activities follow procedure, at least initially. Responders are deployed, incident command established, teams assigned activities, such as traffic control, based on situation priorities, etc. Training supports a timely and structured deployment and response to the incidents.

With the dynamic nature of emergencies, responders adjust their response actions to the conditions and timing of the incident and depend on training to provide the foundation for field decisions. For instance, in Apex, North Carolina, the emergency operations center had to be relocated multiple times. The police station was in the plume exposure area and had to be

evacuated leaving behind a dozen police cars which were then unavailable for use. The emergency response team overcame these conditions and successfully evacuated over 17,000 people safely out of the hazard area in a matter of hours. Another example of applying training skills to an incident occurred with the University of Texas Medical Branch in Galveston, Texas. The evacuation of this facility had been discussed among emergency response personnel in planning activities; however the facilities had never been fully evacuated. The evacuation of the facility was completed in a 12-hour period using ambulances, helicopters, planes, and buses to support this first complete facility evacuation. The agencies responsible for the evacuation made quick and effective decisions directly in line with their training and experience.

Examples of how training provides responders the knowledge to respond and adjust to incident requirements were identified in almost all of the evacuations researched. The training received by emergency management departments located within NPP EPZs was also instrumental in supporting successful evacuations. In Matagorda County Texas, which includes the South Texas NPP, the emergency management department attributed some of their success during Hurricane Rita to the response exercises conducted for the NPP. To support the evacuation, the county implemented some of the emergency response plan elements developed for the South Texas NPP. In St. Charles Parish, Louisiana, some of the off-site emergency response plan elements for the Waterford 3 NPP were also used to support the evacuation. In Apex, North Carolina, the emergency response agency is within the EPZ for Shearon Harris NPP and training was also instrumental in the successful evacuation for the Apex fire.

Responders that would be involved in response to an NPP emergency receive frequent and thorough training which is tested through drills and exercises. Thus, as well as training was conducted and implemented in these large scale emergencies, training for NPP responders is even more thorough.

4.2.2 Public Education

For implementation, education of the public was rated **effective**. The effectiveness of public education is assessed primarily by the response of the public to the protective action orders. Communication from those ordering the evacuation influences the public response; thus, for the rating of public education, this study considers whether the public followed the evacuation orders, when they evacuated, and whether people were adequately prepared to evacuate.

The effectiveness of public education was challenging to assess for this diverse set of incidents. In smaller incidents such as the Hawaii and Romulus evacuations, compliance was high and response was immediate. These were areas where there has been little or no attempt to educate the public prior to the incident. For the Romulus, Michigan fire, the public was generally unaware of the hazardous nature of the facility and had no experience with evacuations. The evacuation for the Hawaii earthquakes included mostly tourists who had no knowledge of what to do in an emergency. In each of these incidents, the public responded to the immediate instructions provided by authorities.

The population in Apex, North Carolina resides within the EPZ for the Shearon Harris NPP and receives emergency planning information at least annually. The Apex evacuation was conducted very orderly and efficiently in spite of the changing wind conditions and need to

frequently relocate the field command center and expand the evacuation area. In California, planning and education of the public on the potential for wildfires was also conducted in some areas. As reported in the Blue Ribbon Report on the California wildfires, the evacuation of approximately 80,000 residents of a mountain community was successful in part due to the public education efforts (Campbell, 2004). In Plaquemines Parish, Louisiana, the Office of Homeland Security and Emergency Preparedness conducts an effective public awareness program, which includes using public health announcements combined with extensive outreach efforts (St. Amant, 2007). The Plaquemines Parish emergency management had also developed public information brochures and delivered these brochures to all residents of the parish. The Governor's Division of Emergency Management in Texas had distributed at least 40,000 public awareness pamphlets in 2005, prior to Hurricane Rita (HRO, 2006).

The rating of effective was based on the fact that there were instances identified in the evacuations where individuals did not follow instructions. There were instances when large segments of the population did not evacuate, such as in New Orleans during Hurricanes Georges, Ivan, and Katrina. There were large shadow evacuations associated with two of the incidents including Hurricane Rita and the Apex fire indicating that large numbers of people evacuated unnecessarily. Finally, there were instances of individuals who did not have the means to evacuate in New Orleans and in Mississippi, and these individuals had not made plans for evacuation. The above issues with evacuation response can be attributed to public education, but can also be attributed to the decision making and communication provided during the incident. There are many reasons that people choose not to follow the orders provided during an incident. Improvements in public education could be developed to specifically target some of these reasons.

4.2.3 Communications

The planning elements identify multiple methods of communicating warnings and notifications to the public. The systems are available, identified for use, and used in the notification process; however, the messages were not always clear to the public. The results of unclear or indecisive communication adversely affect the response of the public and, as seen in some of the incidents assessed, may cause too many or too few people to evacuate.

4.2.3.1 Communications with the Public

Communication with the public was rated **effective**. In most of the evacuations researched, communication with the public on the need to evacuate was timely, accurate and useful, and compliance was high. In a few instances though, the messages to the public were not clear or were not timely resulting in problems. There was an inconsistent approach to communicating with the public during and after these incidents. Lack of communication with the public was attributed to failure in the plans for evacuating the low-mobility population in response to Hurricane Katrina (Wolshon, 2006). In contrast, the messages to the public were frequent and convincing for Hurricane Rita and resulted in a very large compliance; however, according to the House Research Organization, the biggest failure of the Hurricane Rita evacuation was communication to the public (HRO, 2006) which was often not specific resulting in about 2 million people evacuating that did not need to leave.

For natural disasters such as hurricanes where large scale evacuations are ordered, there is usually time to notify the public and provide direction on the protective action. Hurricane direction can be predicted in general, but the precise impact area can change considerably in the 24 hours prior to landfall. As hurricanes develop in the Atlantic or Gulf of Mexico, they are tracked by the National Weather Service, which provides frequent updates on predicted landfall. Response agencies must balance the recommendation for protective actions with the potential for the hazard to affect the actual area. Forest fires and wildfires can change direction quickly and affect areas that may have been considered safe just hours earlier. As demonstrated in the 2003 California Fires, such changes can occur so quickly that there is not always time to notify all of the affected residents, particularly in sparsely populated areas. Natural disasters also present an additional challenge because of the breadth of the impacted area. For Hurricanes Katrina, Rita, and Wilma in 2005, as well as both California fires, the media coverage was extensive, and the general public was very aware of the potential hazard. Such broad coverage is informative, but may not always be specific enough for residents to understand if they are in a mandatory evacuation area.

Common methods used to notify the public included EAS messages, Reverse 911® type systems, route alerting, television news broadcasts, and notifications at special events, such as local football games. The siren system surrounding the Waterford 3 NPP in St. Charles Parish, Louisiana was used as a form of notification for Hurricane Katrina and was effective in getting the initial notification to the community. One of the most successful communications methods continues to be door-to-door notification and route alerting. This is a slow and labor intensive effort, but it assures that residents have been contacted. Route alerting was used to some degree in most of the incidents studied. For the Romulus and Apex chemical fires and California fires, route alerting was widely used as a method to inform the public. It was also used in many areas of Florida, Mississippi, Louisiana and Texas for hurricanes, but on a more localized basis such as in mobile home parks and low lying neighborhoods.

Multiple methods of communication were used in every incident. This approach helps to inform larger numbers of the public, but this does not always ensure a high percentage of the public receives the message. In Hurricane Charlie in 2004, the Lee County Florida emergency management program used thirteen different means to communicate with the public including media broadcasts, Reverse 911®, and some route alerting (Lee County, 2006). In an after action report, it was determined that fewer than 30 percent of those ordered to evacuate actually left. Less than 20 percent of the public stated they heard the mandatory evacuation order. The telephone information system only reached 10 percent of those called with 40 percent hanging up and 40 percent not answering (Lee County, 2006). Providing multiple means of notification increases the probability that the public will hear the message and provides a means by which they can verify the information.

When considering forms of communication, demographics must be considered. In New Orleans, some information was communicated in Spanish and Vietnamese, while in Florida some information was published in Spanish, French and German. There was little information identified in the research of real time communication of evacuation information during news broadcasts, although one report was found where a televised evacuation message was presented in Spanish in Mississippi and local Spanish television networks covered the 2003 and 2007 California fires.

Some States, including Texas, Louisiana, Florida, California and others did use the 211, 311 and 511 telephone information systems to provide general information to evacuees. The 211 system was a valuable asset in Texas in support of Hurricane Rita (United Way, 2005) and was widely used in the 2007 California fires. Dynamic message signs, which can be programmed remotely and changed as conditions change, were utilized in most of the incidents assessed to provide information to evacuees. Even with these added attempts to communicate with the public during the evacuations, available shelter locations were not always well communicated. Thus, individuals arriving at shelters were sometimes told to continue on to the next available shelter. Providing information resources to evacuees en route is a trend that emergency planners are integrating into their response plans.

Effective notification led to Plaquemines Parish, a coastal parish in Louisiana, recording an evacuation compliance rate of greater than 99 percent prior to landfall of Hurricane Katrina (St. Amant, 2007). But a very broad based message was issued in the Houston area stating that residents who had experienced flooding in the past should evacuate. The evacuation warnings in Houston also emphasized the recent experience with Hurricane Katrina to further encourage residents to evacuate. A more direct message could have been communicated directly to those specific areas of coastal Texas that needed to evacuate and may have limited the evacuation to those who were at risk.

Authorities are learning that how they communicate evacuation orders has an impact on the response. The public must believe that if they are ordered to evacuate, it is because there is a real threat to the community. To reduce evacuation of areas that are not at risk, authorities should assure that when they order an evacuation, they do so only for those areas that are potentially at risk. These are difficult and challenging elements to balance when ordering an evacuation. Frequently, such as with hurricanes and wildfires, the direction and impact is not always predictable with much accuracy by the time the evacuation orders must be made. During the 2007 California fires, emergency response personnel stated that the mayor of San Diego had asked that people not affected by the fires to refrain from driving when possible to support the evacuation efforts.

4.2.3.2 Communications with Emergency Responders

Communication with emergency responders was rated **very effective** based on the resources, planning and infrastructure dedicated to and used in response activities. Emergency response professionals are frequently required to overcome issues with communications and routinely demonstrate that through training and ingenuity, they have the ability to overcome these issues. Emergency response agencies have aggressively updated their communications systems over the last five years. However, there are still frequent communication issues with emergency response radios and communication systems such as interoperability problems between systems of different jurisdictions. Radio frequencies can be overwhelmed with too many participants, and telephone networks can become inundated with calls sometimes making communication between emergency response organizations difficult

In spite of upgraded systems, there remain some common issues encountered in response to emergencies. During Hurricane Wilma, there were issues with overload of the 800 MHZ radio system used by the county (Lee County, 2006). This was partly due to the loss of two

communication tower links and to the number of users on the system. Interoperability issues between the multiple response agencies was a finding in the California Blue Ribbon Report. During the 2003 California wildfires, incompatible communication systems often made it impossible for strike teams to communicate with incident commanders. Fire fighters used their ingenuity to compensate for the communication problems resorting to cell phones, two way radios, and even special signals on their engines (Campbell, 2004). The need for improvement in communications was identified as a finding in the Blue Ribbon Report. The improvements implemented after the 2003 California fires resulted in a response to the 2007 California fires that was confirmed by emergency management staff to have had very few communications problems and none that adversely affected the response.

Although interoperability and overloaded systems are still relatively common, the redundancy in the communication network generally provides the infrastructure to meet the needs of responders. The use of cell phones, telephones, and back up radio are common in every incident. Cell phone systems can be overloaded as well, but there are systems in place, that when implemented, restrict the use of cell phones to emergency responders. Use of WebEOC® applications in some of the incidents also helped assure accurate information was available quickly among responders. There were no incidents identified where communication issues impacted the overall success of an evacuation.

4.2.4 Evacuation

The implementation of evacuations was rated as **effective**. In establishing this rating, an attempt was made to review the entire evacuation and not allow individual decisions or isolated problems to skew the rating. Evacuation was rated as effective because the resources were generally available, the infrastructure generally adequate, and the processes generally sufficient to meet the response needs. For some of the incidents researched, less than adequate implementation of processes was identified.

In the review of the ten evacuations, it is evident that as the geographic area and number of evacuees increase, errors in decision making can result in greater consequences. The transportation issues encountered during the evacuation for Hurricane Rita were directly linked to the evacuation orders which were very broad. Likewise, the late decision to order a mandatory evacuation for New Orleans contributed to the low compliance pre-landfall evacuation of the city which led to deaths caused by the hazard (United States, 2006a). Such decisions are effectively a failure to follow planning. Decisions that deviate from planning are less likely to occur during an emergency for an NPP where plans including decision chain actions are exercised routinely. Among the non-hurricane evacuations assessed in this project, generally fewer agencies were involved, and the decision processes was more localized. In these instances, the decision making processes appeared to be more direct and resulted in evacuations that were very successful.

All of the incidents reviewed had resources to support the anticipated evacuation, although not all of the necessary resources were utilized. As volumes of traffic increased above the anticipated levels, resources were quickly diminished in some incidents, and the transportation system became overwhelmed as seen in the traffic congestion for Hurricanes Georges, Ivan and Rita. Evacuation routes were usually well defined either through use of evacuation signs,

barricades, or manned intersections where traffic control officers directed evacuees. In south Texas where the large number of evacuees inundated the transportation network, the infrastructure could not support the evacuation. In that part of the State, the outbound Interstates narrow to two lanes shortly out of the Houston area, and the capacity of the roadway infrastructure was not adequate for the number of evacuees.

Evacuees were directed to a large extent by the law enforcement agencies involved. These agencies established traffic control points by posting officers at intersections and barricading areas to direct traffic along the evacuation routes. This is a labor intensive approach that has been demonstrated as one of the most effective means of facilitating traffic flow, and was utilized in all of the evacuations assessed. In discussions with Mississippi and Louisiana emergency personnel, providing manned intersections in the receiving cities to help disperse traffic as it arrives was demonstrated to improve traffic flow for the Hurricane Katrina evacuation. This was a lessons learned from previous evacuations. For the Hawaii earthquake and Romulus fire, few intersections required barricades or manned personnel to direct the traffic. In Apex, North Carolina, traffic control had to be relocated multiple times as the wind blew the plume in different directions affecting the evacuation routes. Traffic control also had to be adjusted during the evacuations for the New England floods, which affected a large area and had an added impact of hundreds of roads having been flooded out.

Through integration of lessons learned, the Gulf Coast States had improved their evacuation planning, and travel times for the Hurricane Katrina evacuation, although lengthy, were significantly improved over previous evacuations. Louisiana transportation officials had integrated lessons learned from Hurricane Pam and Hurricane Ivan and revised the State contraflow plan which was a key factor in the successful evacuation of Louisiana. Contraflow is the reversing of lanes to allow more traffic to travel in a specific direction. For Hurricane Katrina, contraflow was initiated early, was well organized with plenty of access points and was considered successful. Contraflow has also proven successful for hurricanes in Alabama and other coastal States, but it must be implemented efficiently. Alabama revised their evacuation plans, practiced to reduce the time required to reverse traffic flow on major routes, and encouraged local officials to define smaller evacuation zones within their jurisdictions to better target evacuation actions (United States, 2006a). By integrating lessons learned and working with transportation planners, Louisiana was able to improve their contraflow plans after using contraflow in Hurricane Ivan.

Contraflow is not always effective as demonstrated in Hurricanes Ivan and Rita. For Hurricane Ivan, contraflow was implemented, but the loading and unloading of traffic was not optimized and actually contributed to congestion. In response to Hurricane Rita, contraflow was implemented late, as a corrective action, to alleviate already congested roadways. Implementation of contraflow while the roadways were heavily congested took additional time. When the contraflow was finally in use, it did help with traffic flow.

Infrastructure is never designed to accommodate evacuation level traffic (Wolshon, 2006). Therefore, traffic management needs to be optimized to facilitate the large volume of traffic during an evacuation. Prior to Hurricane Katrina, few States integrated transportation planning agencies with emergency response agencies in an attempt to optimize traffic management. In the evacuation of Hurricane Ivan, the contraflow operations in Louisiana did not work effectively.

Louisiana then integrated the expertise of these agencies, the success of which was evident in the evacuation for Hurricane Katrina. Following the guidance of transportation planners, the implementation of contraflow for Hurricane Katrina was improved and worked very well.

The use of buses to support public evacuation works very effectively when the logistics are pre-defined. Buses were used to support evacuations in six of the evacuations researched. In response to Hurricane Rita, the City of Galveston, Texas transported approximately 4,000 people using buses. Harris County, Texas evacuated approximately 50,000 individuals using mostly commercial buses and some school buses (Harris County, 2006). School buses, although convenient, do not have air conditioning and have no space for cargo and are not well suited for lengthy evacuations. Additionally, the capacity of school buses is usually based on children, and this must be taken into account. Emergency response personnel supporting the evacuation of Galveston, Texas said that buses filled with adults, children and belongings generally held about 50 percent of their rated capacity when full. The planning for management of pets on buses was not in place at the time of the evacuation for Galveston, and decisions were made at the time to allow pets on the buses. These pets included dogs, cats, birds, snakes, etc. Individuals who supported the evacuation stated that allowing pets on the buses worked relatively well. It was the lengthy multi-hour bus rides that contributed to difficulties with pets overheating, and there were food, water and waste problems. Issues such as travel time are important considerations, but are not likely to be an issue when evacuating a 16 km (10 mile) EPZ where travel distances and times are considerably less than those for hurricanes.

It was well publicized that New Orleans did not use all of the available municipal buses or local school buses to support the evacuation, with only twenty buses used to transport individuals to the Superdome (United States, 2006a). The lack of available buses became a high profile lessons learned after Hurricane Katrina. Large scale use of buses for any future evacuation of New Orleans is now coordinated regionally to acquire the necessary number of buses to evacuate the transit dependent population from the city (Montz, 2007). The lead time to mobilize these resources is quite long and will require decisions to mobilize long before a confident prediction of the hurricane landfall location can be determined. The planning for EPZs provides that buses supporting an evacuation be identified and the time to mobilize and evacuate the residents that require public transportation be estimated (NRC, 1980). The implementation of busing is evaluated during NPP offsite exercises.

For a large scale evacuation to be successful, there must be a beginning and an end to the evacuation. More precisely, evacuees must have a place to go that is ready to receive them. This necessitates a need to have a regional approach that includes coordination of evacuation plans with adjoining jurisdictions (DOT, 2006). This also provides evacuees a means to enter and exit the transportation network in a controlled manner. In Mississippi, the traffic control implemented for the evacuation extended north to Hattiesburg, Mississippi to provide controlled vehicle egress. This was a lesson learned from previous evacuations where congestion was encountered because controls were not in place. Similarly, the evacuation of southern Louisiana in response to Hurricane Katrina included traffic control in Baton Rouge and the closure of one lengthy (approximately 64 km or 40 mile) segment of an area Interstate to facilitate the passage and exiting of traffic.

4.2.5 Special Needs

Special needs facilities were evacuated in all but one of the incidents assessed. There were no special needs facilities evacuated during the chemical fire in Romulus, Michigan. Although there are many instances of very effective actions in evacuating select facilities and individuals, the sheer number of casualties from Hurricanes Katrina and Rita in this category necessitates a low rating.

4.2.5.1 Special Needs Facilities

The implementation of the evacuation of special needs facilities was rated **marginally effective**. Special needs Medicaid and Medicare certified facilities are required under 42 CFR 483.75 to have detailed written plans and procedures to meet all potential emergencies and disasters. But these plans are not often coordinated with the local or regional emergency response agencies. This results in little or no coordination of resources to support the evacuation of these facilities. In smaller communities, emergency response managers reported contacting facilities directly to assure that they had the resources necessary to evacuate and to determine if they needed any additional evacuation support (St. Amant, 2007). In larger communities, direct communication with each facility was not conducted, and there was no organized approach to contact these facilities to assure they were making arrangements for evacuation.

Special needs facilities were evacuated during the New England flooding including at least one nursing home, a senior citizen community, and a half-way house (CBS, 2006). It took approximately 10 hours to evacuate the nursing home, when a hoist was required to be constructed to safely move non-ambulatory patients from a sub-level floor. In Lawrence, Massachusetts, a large nursing home with approximately 245 residents was evacuated after flooding had reached the facility. Some evacuees were floated out of the facility in laundry bins (Catholic Health World, 2006). In Apex, North Carolina a nursing home with approximately 100 patients was successfully evacuated in approximately 3.5 hours without incident. In Hawaii, approximately 3,000 people were evacuated because of the earthquake, the majority of which were from hotels and the Kona Community Hospital. Some of the patients were flown to other facilities for care. In at least four of the evacuations studied, patients were successfully airlifted out of the hazard zone. In another positive and very successful action, the University of Texas Medical Branch in Galveston completely evacuated in a 12-hour period using ambulances, helicopters, planes, and numerous public and school buses to support this first time full evacuation of the facility. Hundreds of special needs patients were airlifted out of the Southeast Texas Regional Airport. Although evacuation of the medical branch had been discussed among responders, the implementation of the evacuation was largely ad hoc.

In Louisiana and Texas, the evacuation of special needs facilities was not generally successful. In the response to Hurricanes Rita and Katrina, there were widespread reports of difficulties and issues related to the evacuation of this population group. Most of the nursing homes had evacuation plans, and the decision to evacuate, in many cases, was left to the operator of the home. For those homes that chose not to evacuate, there was no post-evacuation process to confirm whether these individuals were evacuated. In Texas and Louisiana resources required to support evacuation of special needs facilities were sometimes double-booked and not

available for all of the facilities when needed (HRO, 2006).

In the evacuations for Hurricane Katrina and Rita, it became obvious that evacuation plans for special needs facilities are not generally coordinated with community evacuation plans. Some special needs facilities relied on the same bus or ambulance services, not considering that the transportation service only had vehicles for a limited number of facilities (USACE, 2007). In some instances, where buses were available, trained drivers were difficult to find. In Hurricanes Katrina and Rita, many drivers evacuated with their families. For these evacuations, the planning for special needs facilities was generally ineffective. The resources necessary to support evacuation of special needs facilities and individuals require planning with the appropriate level of detail and coordinated with local and State emergency planning to optimize the use of the limited resources available. NUREG-0654 states that for emergency planning within EPZs, special facilities should be considered separately from the general population so that details can be developed at the facility level.

4.2.5.2 Special Needs Individuals

The implementation of the evacuation of special needs individuals was rated **marginally effective**. This population group has become widely publicized since the evacuations for Hurricane Katrina and Rita. Evacuating those with special needs who do not reside in special needs facilities begins with defining and locating these individuals. Some local agencies maintain lists of persons with various special needs (St. Amant, 2007), but information for many agencies is incomplete or outdated. There have been longstanding opportunities for residents to register with their local emergency management agency, but the voluntary disclosure rate is low. The State of Florida has a very aggressive program to identify special needs individuals and their evacuation needs (HRO, 2006). To improve in this area, New Orleans is establishing a 311 telephone information hotline to register residents with special needs (FHWA, 2006). Plaquemines Parish, Louisiana had the most comprehensive and proactive program identified in the research and has a very high registration rate (St. Amant, 2007).

As noted in “A Failure of Initiative” (2006a), New Orleans was unprepared to provide evacuations and medical care for its special needs population, and Louisiana officials lacked a common definition of “special needs.” In 2005, New Orleans did not have an adequate number of buses to support the evacuation of the transit dependent population even though the City of New Orleans Comprehensive Emergency Plan (2005) identified that 100,000 people were potentially without means to evacuate. Prior to landfall of Hurricane Katrina, New Orleans had over 400 municipal buses available of which twenty were used to transport people to the Superdome (United States, 2006a). Additional hundreds of school buses that were not used to support the evacuation prior to landfall were flooded after the levees breached.

Historically, very few individuals, including elderly and frail individuals, died as a direct result of an evacuation (NRC, 2005a). This statistic held true for Hurricane Katrina, where in the evacuation of more than a million people, only one nursing home resident was identified through research as having died during the pre-landfall evacuation (Times-Picayune, 2005). In the evacuation for Hurricane Ivan, four elderly individuals in New Orleans died during the evacuation. In the response to Hurricane Rita some residents that evacuated from nursing homes and hospitals did die during or as a direct cause of the evacuation (Henk, 2007).

Additionally, there were nursing homes and hospitals in the New Orleans area that did not comply with evacuation orders, and many residents of these facilities died after the flooding of the city when food, water, electricity, and air conditioning were no longer available. Licensed facilities are required to have evacuation plans, and it is incumbent upon those in charge of these facilities to implement such plans. Since these recent hurricanes, protocols for coordination of evacuation resources as well as better evacuation planning for special needs facilities are being developed.

Florida emergency management has a more mature program for the evacuation of the special needs population that do not reside in special needs facilities. Florida has implemented programs for identifying and preparing for this population group before an incident occurs. The Emergency Evacuation Assistance Program, as well as other assistance programs, encourage those who require nursing care, assistance with daily living, or medical support equipment to register with their local Office of Emergency Management. Although Florida has aggressive programs for identifying the special needs individuals, the response rate to these programs is not high. Miami-Dade County has a plan in place to transport people via bus to American Red Cross shelters during a hurricane evacuation. Residents are told to listen to the media or call the 311 non-emergency information line to find out when the buses will transport people from the pick-up points to American Red Cross evacuation centers. In some Louisiana parishes (St. Amant, 2007) and Mississippi communities, a grass roots approach is taken that includes meeting with churches, civic centers, and senior homes to identify those that may require assistance. These proactive approaches achieve a higher registration rate. In other areas, registration cards are mailed that not only ask the resident to register if they have a need, but also to identify friends, neighbors, or relatives that may have a need. The emergency management agency then contacts the individuals directly. This use of registration cards does result in people registering, but it is not as effective as more proactive registration methods as the grass-roots efforts.

Lastly, in the 2007 California fires, the sheriff, police and fire departments had active roles in evacuating special needs individuals. Emergency response personnel stated that when necessary, they evacuated special needs individuals and other stranded individuals in their patrol cars and fire engines. The fires in San Bernardino County started in the morning after residents from the mountain communities had gone into town to work. As a result, there were many latch key kids left at home that required evacuation. For those parents who had not planned for the safety of their children in the event of an emergency, Sheriff department personnel had to divert resources to support the evacuation of these children.

4.2.6 Shelter Facilities

Shelter facilities were established for all of the evacuations researched, and the implementation of shelter facilities was rated as **effective**. This assessment did not overlook the widely publicized problems with shelter facilities in New Orleans after the landfall of Hurricane Katrina. In the context of this project, which is primarily assessing those protective actions that occurred up to the actual hazard, the New Orleans shelters were opened and received a very large number of individuals who were protected from the hurricane hazard. Had the levees not breached, these evacuees would have left the Superdome and Convention Center within a day, and the lengthy stays and post-flooding issues would likely not have occurred.

In Louisiana, shelter facilities were used extensively for Hurricanes Katrina and Georges, but were used in a limited manner for Hurricane Ivan. Almost 200 shelters were opened within the Gulf States, including 88 shelters in Louisiana in response to Hurricane Georges (Pine, 2003). The Superdome was opened for the first time and was intended to be a special needs shelter only. However, it became a shelter of last resort because there were thousands of individuals who had not evacuated. In the parishes surrounding New Orleans and throughout the rest of Louisiana, the shelter program is well established and was implemented with success in Hurricane Katrina and previous hurricanes. During Hurricane Katrina, special needs shelters were opened in Lafayette, Alexandria, Baton Rouge, and Monroe, Louisiana and other locations. Shelters were also opened on a wide scale in Mississippi, Georgia, Alabama, and Florida for Hurricane Katrina.

In Monroe County Florida, emergency response agencies generally open shelters for Category 1 and 2 hurricanes. For more intense hurricanes, shelter locations are coordinated with inland counties. In response to Hurricane Wilma, a Category 3 hurricane at landfall, over 100 shelters were opened in Florida, including some in Monroe County. Busing was available to transport individuals to these shelters. In response to Hurricane Rita, the very limited number of available shelters in the Houston, Texas area required evacuees to travel as far as Austin, San Antonio and Dallas, where shelters were available. Shelters filled to capacity quickly and many evacuees were turned away from shelters nearer to Houston and had to continue traveling until they could find an available shelter or hotel. In Mississippi shelters are established in response to hurricane threats including facilities used as shelters of last resort and shelters for individuals with special needs. Prior to the evacuation for Hurricane Katrina, contracts were in place with ambulance services to transport special needs individuals to shelters. To locate individuals with special needs, the local officials combined their special needs individuals list with a special needs list from the ambulance service.

Florida and Mississippi, as well as other States, had pet friendly shelters available. However, pet friendly shelters are still limited, and in some cases, pet owners may be separated from their pet. In order to improve upon the evacuation of pets, on October 6, 2006 the “Pets Evacuation and Transportation Standards Act of 2006” was signed into law amending the Stafford Act to ensure that State and local evacuation plans address the evacuation of pets.

For the Hawaii earthquake, California fires, Apex and Romulus chemical fires, and many of the communities affected by hurricanes, the shelter facilities were established as planned and utilized with few incidents. For the larger evacuations, shelter capacity was frequently exceeded and pet friendly shelters were typically not widely available. The California fire evacuations were very receptive to pets and included evacuation of hundreds of horses as well. Pets were allowed in QualComm stadium and other shelters. Florida and Mississippi, as well as other States, are developing more pet friendly shelters to accommodate evacuees with pets. Many elements of the shelter programs worked well, and they also are improving with implementation of lessons learned.

4.2.7 Summary of Implementation

The implementation of emergency response elements was reviewed for each of the ten evacuations and compared to the established criteria. Training and communication with

emergency responders received very effective ratings which correspond to the very effective planning ratings also received for these two categories. Special needs received a marginally effective rating, which also corresponds to the planning rating assigned. There were excellent individual performances identified in almost all of the incidents reviewed, such as the timely and effective evacuation of Apex, North Carolina, Romulus, Michigan, Galveston, Texas, and Plaquemines Parish, Louisiana. Figure 4.2 provides a summary of the effectiveness of the implementation elements.

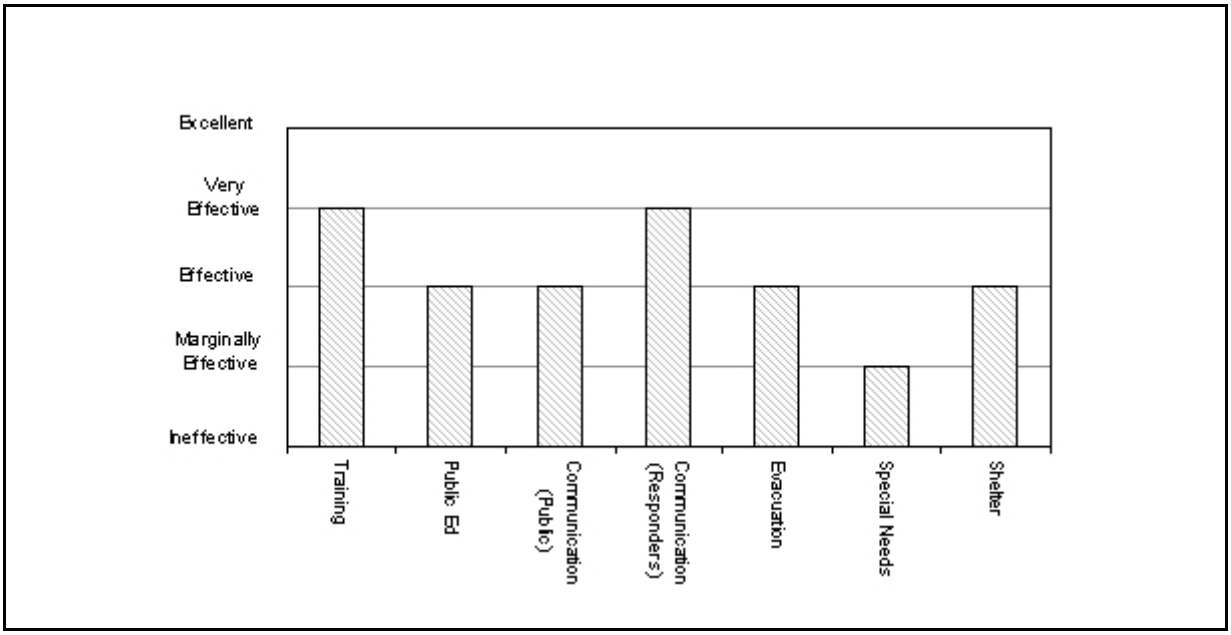

Figure 4.2 Relative Rating of Implementation

4.3 Summary of Analysis of Incident Response Elements

Having reviewed the incidents against the criteria defined earlier, the elements received ratings of marginally effective, effective, or very effective. Figure 4.3 presents the effectiveness ratings for each category. The rating for each element was established independently for both the planning and implementation sections. The ratings are qualitative and subjective based on professional judgement and expertise. In preparing Figure 4.3, it became evident that the ratings for planning corresponded directly to the ratings for implementation. This result reinforces the concept that the success of the implementation is directly related to the level of preparedness. Also evident in Figure 4.3 is that most emergency response elements are effective or very effective. This is indicative of the mature nature of emergency response, the extensive training, and the culture of emergency response organizations.

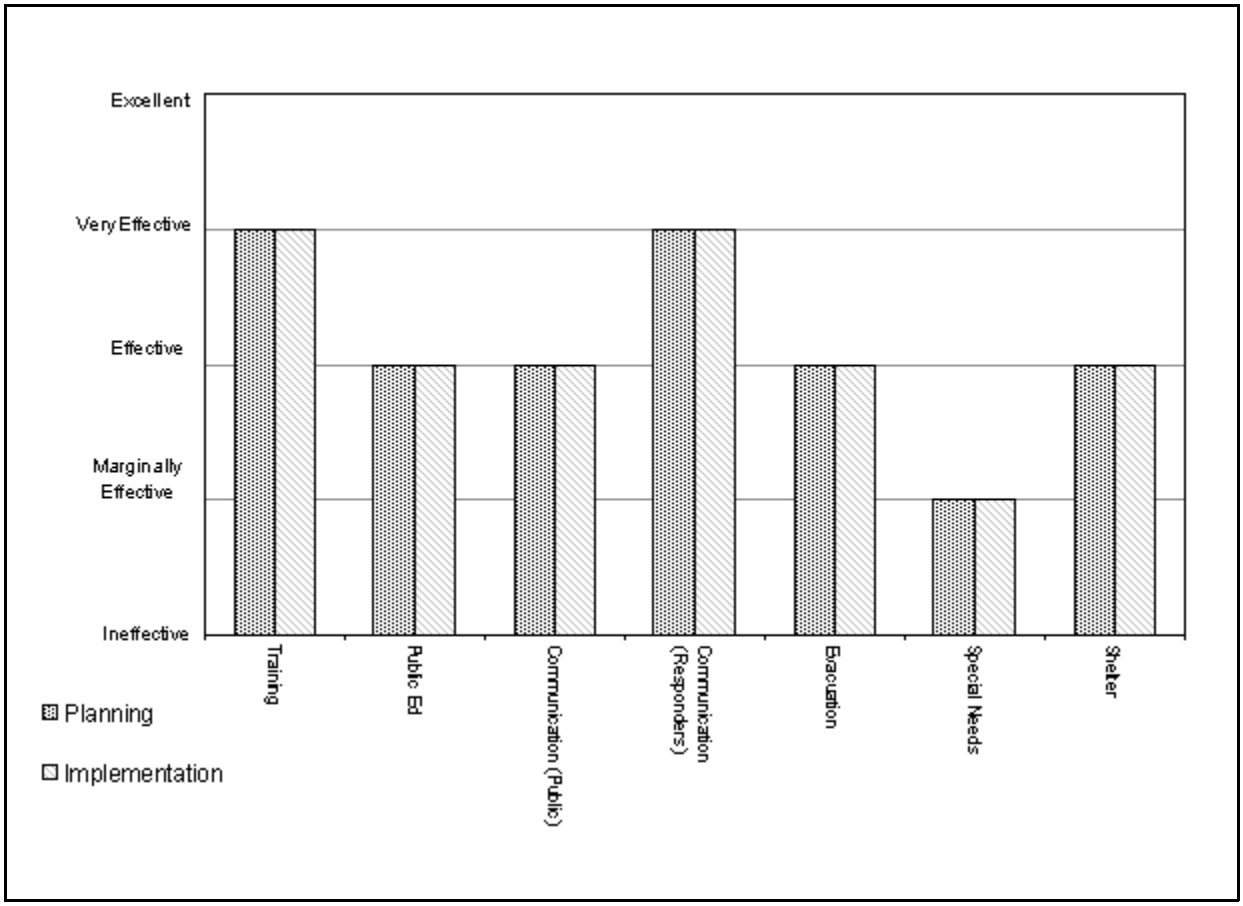

Figure 4.3. Relative Rating of Planning and Implementation

The emergency response planning and implementation for special needs individuals and facilities received the lowest rating. Primary reasons for this rating include the lack of coordinated planning for special needs facilities and the lack of planning for special needs individuals who do not reside in special needs facilities. This is an area that is currently receiving much attention and improvement.

The investigation and research that has been conducted by the Federal government, universities and private industry since Hurricanes Katrina and Rita has identified many areas of improvement in emergency response. The DHS, NRC, FEMA, States, counties, parishes and local authorities are implementing improvements to the emergency response program to assure that the response for large scale incidents addresses lessons learned and better meets the needs of the public. Examples of response to lessons learned include NRC completion of priority recommendations identified in the 2005 Hurricane Season Lessons Learned Task Force (NRC, 2006), the passing of pet evacuation bills at the State and Federal levels, the planning for regional busing to support large scale evacuations, the efforts in Florida to improve the shelter program, and the efforts in Louisiana and Mississippi to coordinate and improve implementation of contraflow.

5.0 NRC and FEMA Emergency Preparedness Program

5.1 Introduction

Section 4.0 provided an assessment of the effectiveness of planning and implementation of selected emergency response elements for ten of the incidents investigated. These assessments identified insights and lessons learned that may be beneficial to the NRC and / or FEMA emergency preparedness program. The following section presents a discussion of the seven emergency planning elements and the NRC and FEMA emergency preparedness regulatory, programmatic and guidance documentation.

Before an operating license can be issued for a nuclear power reactor, the NRC must make a determination that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Onsite emergency plans developed by the license applicant, and offsite plans developed by the State and local organizations, are required to meet the planning standards of 10 CFR 50.47(b). These emergency plans establish response organizations, methods, resources, and capabilities for responding to emergencies at the facility. Implementing procedures provide detailed instructions directing this response. The offsite plans are generally integrated with the all hazards planning for the jurisdiction. The onsite and offsite response capabilities are initially and periodically evaluated by NRC and FEMA, respectively, through review of plans and procedures and evaluation of emergency exercises and drills. The NRC bases its licensing decisions, in part, on its assessment of the onsite capabilities, and on a review of FEMA's assessment of the offsite capabilities. If at any time after the license is issued, NRC or FEMA should determine that reasonable assurance does not exist, the NRC must take steps to see that the deficiencies are remedied and whether other enforcement actions are warranted.

The incidents investigated in this study included technological hazards and natural disasters. The size of the evacuation areas ranged from a 1.6 km (1 mile) radius for the Romulus chemical fire to the multi-State evacuations for hurricanes. NUREG-0654/FEMA-REP-1, Rev. 1 (NRC, 1980) establishes the EPZ around an NPP at about 16 km (about 10 miles) with the understanding that detailed planning within the EPZ provides a substantial base for the expansion of response efforts beyond the EPZ in the event this proved necessary (NRC, 1980). Furthermore, in the unlikely event of an NPP accident that requires an evacuation, the evacuation may be implemented for a portion of the EPZ, may involve the entire EPZ, and although very unlikely, could involve areas beyond the EPZ. Most often, a keyhole evacuation, based on wind direction would be the preferred evacuation strategy. The population within the keyhole area would be evacuated and the keyhole would be expanded if wind conditions change. The application of insights and lessons learned from the evacuations researched are considered in the context of the size of the affected area and the number of people potentially affected.

5.2 Regulatory and Guidance Document Review

For this assessment, a detailed regulatory, programmatic and guidance document review was conducted and included the following documents:

- **10 CFR 50.47** - Emergency Plans;
- **Appendix E to Part 50** - Emergency Planning and Preparedness for Production and Utilization Facilities;
- **Management Directive 8.2** - NRC Incident Response Program;
- **NUREG-0728** - NRC Incident Response Plan;
- **NUREG-0654/FEMA - REP-1, Rev.1** - "Criteria for Preparation and Evaluation of Radiological Emergency Response and Preparedness in Support of Nuclear Power Plants."
- **NUREG-0654/FEMA - REP-1, Rev.1, Supplement 3** "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants" Draft Report for Interim Use; and
- **67 FR 20580**, "FEMA Radiological Emergency Preparedness: Exercise Evaluation Methodology," April 25, 2002.

Only those elements applicable to this study were evaluated. Elements such as onsite controls, radiation monitoring, contaminated workers, etc., are not relevant to this study of evacuation related activities and are not included in the review.

The above documents were selected because they establish the foundation of the emergency preparedness program. Except as provided, 10 CFR 50.47(b) requires that onsite and offsite emergency response plans for NPPs meet the 16 planning standards of paragraph (b). 10 CFR 50.47 (b)(10) states in part that "A range of protective actions has been developed for the plume exposure pathway EPZ for emergency workers and the public." The public is all persons located within the EPZ, including residents, transients, special needs individuals, and any other member of the public. Appendix E to Part 50 requires that licensees and applicants provide an analysis of the time required to evacuate and for taking other protective actions for various sectors and distances within the plume exposure pathway EPZ for transient and permanent populations.

The NRC Management Directive 8.2 (NRC, 2005c) is the programmatic document for the NRC Incident Response Plan, NUREG-0728 (NRC, 2005d). This directive is used to identify NRC organizational responsibilities that provide assistance, commit staff, and manage the NRC response to incidents. The NRC Incident Response Plan (NRC, 2005d) provides the framework for NRC interface and coordination with licensees and other stakeholders during incidents. The function of these documents is to support the NRC response to emergencies. The NRC Incident Response Plan includes detailed information on roles and responsibilities, capabilities, and activities undertaken by the NRC for a nuclear emergency, and includes the concept of operations for incident response. The NRC Incident Response Plan also describes the link between the NRC's response and the National Response Plan which was superceded by the National Response Framework in January, 2008 (DHS, 2008). Under the National Response Framework, NRC is the Coordinating Agency for events occurring at NRC-licensed facilities and for radioactive materials either licensed by NRC or under NRC's Agreement States Program. If the severity of an event is significant, rises to the level of General Emergency or is terrorist

related, DHS will take on the role of coordinating the overall Federal response. In such cases, NRC retains a technical leadership role as a cooperating agency.

NUREG-0654/FEMA-REP1, Rev.1, (NRC, 1980) was developed to provide a common reference and guidance source for State and local agencies and licensees in the development of radiological emergency response plans. The final document included in this review is the, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, EPA-400-R-92-001, (EPA, 1992). This document was included in the review, but was not evaluated for Table 5.1. As an EPA document, it includes information on protective actions and is an integral part of radiological emergency response planning but is not directly related to most of the emergency planning elements .

5.2.1 Radiological Emergency Preparedness Program

Emergency preparedness programs developed in accordance with the above regulations and guidance are evaluated through Radiological Emergency Preparedness (REP) exercises which are designed to test the capability of offsite organizations to protect public health and safety through the implementation of their emergency response plans and procedures under simulated accident conditions (FEMA, 2002). The exercise evaluation criteria were established in the following documents.

- **FEMA-REP-14** - Radiological Emergency Preparedness Exercise Manual (FEMA, 1991a);
- **FEMA-REP-15** - Radiological Emergency Preparedness Exercise Evaluation Methodology (FEMA, 1991b); and
- **67 FR 20580**, "FEMA Radiological Emergency Preparedness: Exercise Evaluation Methodology," April 25, 2002.

A draft FEMA "Radiological Emergency Preparedness: Exercise Evaluation Methodology" was published in the Federal Register April 25, 2002, and lists the following six Exercise Evaluation Areas:

1. Emergency Operations Management
2. Protective Action Decisionmaking
3. Protective Action Implementation
4. Field Measurement and Analysis (not applicable to this study)
5. Emergency Notification and Public Information
6. Support Operations/Facilities

Each of the evaluation areas includes sub-elements that provide more detailed criteria. Exercises are conducted and evaluated following these FEMA criteria, and Final Exercise Reports are prepared.

5.2.2 Supplemental Documentation

To support a comprehensive review, supplemental documentation was also reviewed including:

- FEMA Final Exercise Reports;
- Emergency planning brochures; and
- NRC response procedures.

The Final Exercise Reports are prepared by FEMA when a full participation offsite exercise is conducted at a nuclear power plant. For this project, reports were selected for three nuclear power plants and reviewed to assess how the planning elements were implemented. There were no deficiencies assessed in the three Final Exercise Reports reviewed, but there were some 'Areas Requiring Corrective Action' (ARCAs) identified. An ARCA is defined in FEMA-REP-14 as an observed or identified inadequacy of organizational performance in an exercise that is not considered, by itself, to adversely impact public health and safety.

Over 50 emergency planning calendars and brochures were also reviewed during the course of this research. These public information packages included general as well as specific details on evacuation, sheltering, special needs individuals and other emergency response information. This information represents the actual emergency response information provided to the public. Lastly, NRC emergency response procedures were reviewed for response to hurricanes and response to natural phenomena incidents and procedures describe the early activities in monitoring such events as hurricanes. They detail the activities to be performed prior to landfall of a hurricane as well as post-landfall.

5.3 Assessment of Emergency Planning Elements

The seven emergency response elements in the comparison are training, public education, communication with the public, communication with emergency responders, evacuation, special needs, and shelter facilities. A high level comparison matrix is provided in Table 5.1. It should be noted that it is not necessary or expected for all of the planning elements to be covered in all of the documents. Discussion of the comparative assessment for each planning element is provided below.

Table 5.1 Comparison Matrix

NRC/FEMA EP Planning Element	10 CFR 50.47	Management Directive 8.2	NUREG 0728	NUREG 0654/FEMA-REP-1	67 FR 20580
Training	✓	✓	✓	✓	NA
Public Education	✓	✓	✓	✓	NA
Communication with Public	✓	✓	✓	✓	✓
Communication with ER	✓	✓	✓	✓	✓
Evacuation	✓	NA	NA	✓	✓
Special Needs	✓	NA	NA	✓	✓
Shelter	✓	NA	NA	✓	✓

5.3.1 Training

The requirements to establish a training program and conduct drills and exercises to validate the training are well integrated within the regulatory framework. Training and the conduct of periodic exercises are addressed in 10 CFR 50.47, and Appendix E to Part 50 requires provisions for the training program be described and offsite plans be exercised biennially. NUREG-0654/FEMA-REP-1, Rev. 1 provides guidance for the implementation of 10 CFR 50.47 and includes detail on types of exercises and drills, including communications drills, fire drills, and medical emergency, radiological monitoring and health physics drills, and radiological emergency response training (NRC, 1980). Management Directive 8.2 establishes the incident response Qualification, Training and Exercises and Drills program within the NRC (NRC, 2005c). Training and exercises are program readiness elements of NUREG - 0728 which includes the conduct and coordination of exercises (NRC, 2005d).

The training for nuclear emergencies among Federal, State and local response personnel is the most comprehensive, mature, thorough and practical of any industry. Training is validated through frequent and comprehensive drills and exercises.

5.3.2 Public Education

The requirement to provide information to the public on protective actions is identified in 10 CFR 50.47(b)(7). The regulation requires that information on how the public would be notified and their expected actions be made available to the public on a periodic basis. Appendix E to Part 50 requires informing the public and transients at least annually and requires that information

provided to the public be addressed in implementing procedures. Consistent with the regulation, NUREG-0654/FEMA-REP-1, Rev. 1 (NRC, 1980) provides that emergency preparedness information be provided annually to the public. Common methods of implementing this guidance include mailing calendars or brochures to every household within the EPZ. Information is also frequently included in the local telephone book.

In assessing the public education element, more than 50 emergency planning brochures and calendars for nuclear power plant EPZs were reviewed. The information packages are intended to help members of the public better understand the potential risk and the expected actions they may be required to take in the unlikely event of an accident. The information packages contain instructions such as what to do if ordered to shelter or evacuate, children are in school, an individual has special needs, etc. Locations of congregate care facilities are discussed and driving directions frequently are provided.

The information provided on school children most often states that children will be evacuated separately, and parents should not attempt to go to the school. An item that is not addressed is the possibility that the school is in a different emergency response planning area than the parent. In this case, there is the possibility that the parent would be directed to a different congregate care center than the child. Also not considered is the likelihood that parents will attempt to pick up their children regardless of instructions not to do so. An enhancement for public education may include considering the effect of parents arriving at the school to pick up their children.

5.3.3 Communications with Public

The regulatory requirements of 10 CFR 50.47 specify that procedures be in place to notify the public. The regulation requires that a means to provide instruction to the EPZ population is established and that content of the messages is established. The plant operator is required to develop and maintain an emergency action level (EAL) scheme that incorporates multiple, diverse, and redundant EALs that identify classification thresholds based on plant parameter indications, reports from plant personnel, and results of surveillance and other assessments. When an EAL is exceeded, the appropriate emergency classification is declared and the offsite authorities are notified of the event and whether public protective actions are warranted.

Appendix E to 10 CFR Part 50 requires a description of the means of notification and that the licensee have the capability to notify State and local agencies within 15 minutes of an incident. The State and local officials must have the capability to then notify the public within 15 minutes of their receipt of notification, if urgent. NUREG-0654/FEMA-REP-1, Rev. 1 provides that administrative and physical means for prompt notification of the public and that plans be in place for notifying the resident and transient population (NRC, 1980). These notification requirements and guidance have driven the development of comprehensive communications systems and plans that are routinely tested and exercised.

In the review of FEMA Final Exercise Reports, communication systems and procedures were found to perform well, but a few ARCAs were identified related to notification and communication to the public. An ARCA is an observed or identified inadequacy of organizational performance in an exercise that is not considered, by itself, to adversely impact

public health and safety. For the ARCAs identified, in each case they were successfully re-demonstrated.

- In one instance, there was an initial EAS message to the special needs population, but there were no follow on messages which were necessary for the special needs population to understand their expected actions.
- In one report, some schools did not know where their tone alert radios were or the purpose of the radios.
- In one exercise, media briefing on evacuation did not include information on evacuation routes or information on school children.
- In one instance, a press release identified that there was a Site Area Emergency; however, sufficient time had passed prior to the announcement of the Site Area Emergency and a General Emergency had already been declared by the site.

The importance of providing clear and direct information to the affected public is recognized and embedded within response procedures. It is also important to provide clear and direct information to the public that is not at risk, although emergency planners are sometimes reluctant to ask people not to leave an area. To limit shadow evacuations and reduce traffic, the public in the region around the evacuation area should be informed of the benefit of following directions, such as, refraining from travel during the main evacuation. An enhancement should be considered in the emergency preparedness program to provide instruction to the population that is not at risk, but located near the areas evacuated.

5.3.4 Communications among Emergency Responders

The requirements established in 10 CFR 50.47 include identifying staffing, resources and procedures needed to communicate with emergency response agencies. Within this regulation are requirements that procedures be in place, provisions exist for prompt communication with response organizations, and adequate facilities and equipment are available. Arrangements for requesting and accommodating State and local staff must also be in place. Each of these requirements are tested in periodic exercises, also required in 10 CFR 50.47.

Appendix E to Part 50 requires a description of the means to notify onsite and offsite agencies and requires an analysis of the time to notify these agencies. Appendix E requires periodic testing among Federal, State, local agencies and the licensee. The guidance in NUREG-0654/FEMA-REP-1, Rev. 1 includes that each organization provide 24 hour per day manning of communication links and that alerting and notification methods be described. Procedures to notify offsite authorities must also be established.

The regulatory and guidance documentation provides significant detail in the requirements for staffing, equipment and procedures to support communications among emergency response agencies. These systems and processes are tested with a minimum frequency established in 67 FR 20580, FEMA Radiological Emergency Preparedness: Exercise Evaluation Methodology, for the Emergency Notification and Public Information evaluation area. The systems are also tested routinely in non-FEMA related exercises.

5.3.5 Evacuation

Development of a range of protective actions, which shall consider evacuation, is required in 10 CFR 50.47. Appendix E to Part 50 requires a description of protective measures taken within the EPZ, including evacuation, identification of officials responsible for ordering an evacuation, and a description of the alerting and activating of response agencies. Appendix E requires consideration of the permanent and transient population groups and an analysis of the time to evacuate.

Evacuation elements are discussed in NUREG-0654/FEMA-REP-1, Rev. 1, Section II.J and in Supplement 3 to NUREG 0654. These documents establish guidance on the evacuation decision process and include discussion on identification of evacuation routes, assessment of population distribution by evacuation area, and projected traffic capacities. Appendix 4 of NUREG-0654/FEMA-REP-1, Rev. 1 provides guidance on the development of evacuation time estimates. Appendix 4 provides guidance that permanent residents, transients, and persons in special facilities be included in the analyses. An estimate is required for each special facility and is to include an assessment of the means of transportation (NRC, 1980). Schools are specified to be included in the special facility group. Appendix 4 to NUREG-0654/FEMA-REP-1, Rev. 1 provides the guidance necessary for applicants to perform an evacuation time estimate.

The lessons learned from the investigation of evacuations revealed that implementation of evacuation planning improves with practice. This finding is very consistent with the findings of NUREG-CR 6864, "Identification and Analysis of Factors Affecting Emergency Evacuations" (NRC, 2005a). The implementation of traffic control is simulated in exercises, but is not always deployed in the field. An enhancement that may be beneficial in evacuation planning would be more detailed assessment of traffic management, particularly where extensive traffic control may be planned. This may include table top exercises or field drills that include locating the traffic control devices, transporting them to designated locations, and installing these devices when appropriate. Drills of this nature may help assure that the resources and time included in the planning for traffic control are appropriately understood.

5.3.6 Special Needs

Although 10 CFR 50.47 and Appendix E do not specifically identify requirements for special populations, the broadly worded requirements are applicable to all segments of the population within the EPZ without exception. Guidance on meeting these regulatory requirements for the various segments of the population is provided in NUREG-0654/FEMA-REP-1, Rev. 1 (NRC, 1980) and in various guidance memoranda issued by FEMA.

5.3.6.1 Special Needs Facilities

NUREG-0654/FEMA-REP-1, Rev. 1 Section II. G, (NRC, 1980) provides that public education and information include the special needs of the handicapped public. Section II.J, provides that plans include a means for protecting special needs individuals whose mobility may be impaired due to such factors as institutional or other confinement. Appendix 4 of NUREG-0654/FEMA-REP-1, Rev. 1 provides that a separate evacuation time estimate of special needs facilities be performed and that a means of transport be described. Schools are to be considered as special

needs facilities (NRC, 1980).

Special needs Medicaid and Medicare certified facilities are required under 42 CFR 483.75 to have detailed written plans and procedures to meet all potential emergencies and disasters. These plans are not always coordinated at the local level as observed in the evacuations researched in this study. The Florida Emergency Status System and the Georgia Division of Public Health are actively developing systems to better identify the resource needs for this population group (FHCA, 2007). An enhancement that should be considered is that evacuation plans for special needs facilities within EPZs include a local review to assure that adequate resources are available based on the expressed needs of each facility. Such a review could be included and assessed under the FEMA exercise evaluation methodology.

5.3.6.2 Special Needs Individuals

NUREG-0654/FEMA-REP-1, Rev. 1, Appendix 4, states that special attention must be given to those households not having automobiles when developing evacuation time estimates. Appendix 4 also provides for an estimate of the time to evacuate the segment of the public dependent on public transportation. The regulations and guidance documents require planning for special needs individuals under the broad requirement that all segments of the population be included in planning. In review of emergency response brochures for reactor sites, information is frequently provided for transit dependent individuals and special needs individuals. Bus routes are sometimes provided with instructions for the individuals wait at the nearest bus stop. There are no instructions on how to get to the bus stop or how long to wait for a bus. There are also no instructions provided on what provisions should be taken, or not taken, to the bus stop.

Almost all of the brochures reviewed included a special needs information form used to register the name, location and special needs of an individual. In discussion with a limited number of response personnel, the response rate using only the registration card is low. In Linn County, Iowa, the Linn County Emergency Management Agency had previously used the registration card approach. However, in the last few years they have initiated a proactive registration effort and work with various service groups to help educate individuals on completing response cards (LLIS, 2007). This proactive effort, coordinated with the Duane Arnold Energy Center, has almost doubled the number of registered special needs individuals since its inception.

Identifying special needs individuals who do not reside in special facilities prior to an incident is an important element in emergency response planning. An enhancement should be considered to establish more detailed guidance for the offsite planning and evacuation of special needs individuals. Such an enhancement should include a comprehensive definition of special needs individuals.

5.3.7 Shelter Facilities

NUREG-0654/FEMA-REP-1, Rev. 1 provides that public information include the location of relocation centers which should be at least 8 km (5 miles) outside of the EPZ and provides that a description of the means of registering evacuees be described (NRC, 1980). There is no specific guidance provided relocation centers for special needs individuals beyond that applicable to all segments of the population.

Almost all of the emergency planning brochures reviewed stated that pets are not allowed in reception centers. A few brochures mentioned that pets should be caged and evacuated with the family and at least one brochure stated that residents should not take their pets with them because reception centers are not equipped to care for pets. The instructions contained in NPP emergency planning brochures could be updated to address the need to accommodate pets.

Enhancements in the guidance for congregate care facilities could include addressing sheltering of special needs individuals and the need to accommodate pets.

5.4 Summary of Regulatory and Compliance Review

The NRC and FEMA emergency preparedness program has demonstrated the ability to respond timely and effectively through successful drills and exercises conducted at specified frequencies. As indicated in this assessment of the seven emergency response planning elements, the NRC and FEMA emergency preparedness program requirements meet the objectives necessary to facilitate successful implementation of the planning elements. Enhancements to the NRC and / or FEMA emergency preparedness program have been identified that would potentially make the program even better.

6.0 California Wildland Urban Interface Fires: 2003 and 2007

6.1 Introduction

In October 2003, Southern California experienced the State's worst ever wildland urban interface fire, and in 2007, California experienced a second large and destructive fire. In the four years between these fires, the State identified lessons learned and implemented numerous recommendations to reduce the risk of similar threats in the future. The 2003 fires consumed about 740,000 acres, claimed 24 lives, destroyed more than 3,600 homes (Campbell, 2004) and caused the evacuation of approximately 100,000 individuals. The 2007 fires consumed more than 518,000 acres (EDD, 2007), claimed at least 12 lives, destroyed more than 2,200 homes, and caused the evacuation of more than 900,000 individuals. The timing of the 2007 fires provided an opportunity within this study to assess the effectiveness of improvements implemented since the 2003 fires.

Wildfire evacuations though similar in many respects to other evacuations, are also very different. They are very fluid and based on the conditions of the event. These fires have no set origin and pattern of movement, thus evacuations are developed as conditions develop. Some areas have designated "emergency routes" but only inasmuch as they are the only routes out of the danger zone. The California Department of Forestry and Fire Protection responds to more than 5,000 fires annually with about 97percent of these extinguished the first day (CDF, 2003). In recent history, there have been many devastating fires in the State, each of which has resulted in lessons learned and improvements. In 1991, the Oakland Hills fire burned more than 1,600 acres, destroyed approximately 3,400 homes, and claimed 25 lives (CDF, 2003). In 1993, the Laguna Beach Fire destroyed approximately 400 homes, and other fires in Southern California the same year destroyed another 1,200 structures prompting the development of the California Fire Plan. In 1993, the State passed the Standardized Emergency Management System Act (SEMS) and established Fire Safe Councils (CDF, 2003). The SEMS required the State of California to use a standardized emergency management system from which the ICS later evolved. In 2002, MAST was organized which included extensive pre-event planning efforts, elements of which are emergency preparedness and evacuation.

Following the 2003 fires, the governor of California formed the Blue Ribbon Commission to conduct a review and present recommendations to help make California less vulnerable to fires in the future (Campbell, 2004). In addition to the Blue Ribbon Report, many After Action Reports and lessons learned documents have been published that also assess elements of the response to the fires. These reports provide a basis for which effectiveness of improvements that were integrated as a result of lessons learned are assessed. The intent was to determine how these lessons learned may have benefitted or improved the response in 2007 and whether such improvements might be beneficial to the NRC and / or FEMA emergency preparedness program.

6.2 Identification of Lessons Learned

In 2003, prior to the fires, the awareness of fire risk in California was high and efforts were undertaken to plan and pre-stage resources. Some of the efforts undertaken included the

declaration of a State of Emergency in March, 2003 that required agencies to take a number of steps to reduce risk including preparing safety / evacuation plans. The Predictive Services branch at the Forest Service Southern Operations Center in Riverside, California monitored weather and fuel conditions in the region (CDF, 2003). On October 20, 2003, the Forest Service moved additional aircraft into the southern California region. Such proactive planning and pre-staging of equipment were unprecedented for response to a potential fire threat. After months of planning and readiness activities, on October 23, 2003 the fire siege began. Although well prepared, the combination of fuel, wind, and shear number of simultaneous fires were impossible to control.

In the development of after action reports and other studies related to the evacuations, many lessons learned have been compiled. Lessons learned, findings, and recommendations for the 2003 fires were identified in the Blue Ribbon Report (Campbell, 2004) including:

- There were no minimum Statewide training standards.
- A comprehensive public awareness program was needed.
- Communications interoperability was essential for effective command and control during mult-agency, multi-discipline responses to major incidents.
- It was recommended that all EOCs dedicate a Public Information Officer (PIO) or establish a JIC.
- It was recommended that local governments improve public outreach and emergency evacuation education.

Agency After Action Reports and post-incident assessments also included lessons learned in core areas of training, preparedness, education, and communication (CDF, 2005) some of which include:

- Implementation of a JIC was needed early in an incident to provide a unified message to the community, public and media (Maxfield, 2004).
- Development of a multi-jurisdictional evacuation plan was needed (Mutch, 2007).
- Radio communication problems caused coordination problems between agencies and units in the field and prohibited effective situation awareness (Maxfield, 2004).
- Cell phones can augment communications, but these systems become overloaded.
- There was a need to provide evacuation information Spanish as well as English (CDF, 2004).
- Agencies that had trained together functioned more effectively as a unified team (Maxfield, 2004).

6.2.1 Improvements from Lessons Learned

The lessons learned that relate to the seven emergency response elements considered previously in this study are discussed below.

Training
Since the 2003 fires, more than 377 firefighters have been trained in wildland urban interface firefighting techniques (CDF, 2005). In addressing lessons learned related to training, the Forest Service has increased the numbers and readiness of firefighting resources. The Forest

Service has also implemented a leadership training course with the intent of increasing the abilities of leaders to make appropriate decisions and take independent action when necessary (CDF, 2005). Incident Management Teams are either pre-positioned or required to be in place within 12 hours whereas this requirement used to be 24 hours (CDF, 2005).

Public Education

Public education improvements included an increase in the number of Fire Safe Councils to more than 90 (CDF, 2004). Fire Safe Councils primarily address pre-fire management such as fuel reduction and protection of communities and are a means of integrating community support (Campbell, 2004). Information staff has been increased (CDF, 2004) to provide additional individuals who are instrumental in the proactive education of the public, officials, and the media regarding increased risk of wildfire (CDF, 2004).

Communication with the Public

Communication with the public, including timely notification, is vital if an area is to be evacuated prior to the onset of the hazard. Multiple methods of communication with the public are usually attempted. In 2003, the Cedar Fire had moved quickly and evacuation notification for this fire was primarily by door-to-door contact or via loudspeakers on emergency vehicles. San Diego County normally would also use the EAS, but it was deemed impractical at the time because the information would be inaccurate do to the swiftness of the fire and the late hour of the notification at 12:01 am (CDF, 2004). In 2007, the City of San Diego used all methods available to notify the public of the need for action. Methods used to notify residents in the path of the Witch Creek / Guejito fire included:

- Door-to-Door;
- Police and Fire sirens;
- Police and Fire vehicle and helicopter lights;
- Media outlets;
- EAS;
- Reverse 911®;
- AlertSanDiego mass notification system; and
- Community Access Phone System.

In addition, the 211 information line was available with operators who had current knowledge of the incidents. San Diego County personnel said that the 211 system, although overwhelmed in this response, was helpful in reducing calls into the 911 emergency system. The Reverse 911® system sent out almost 15,000 calls predawn on October 22, 2007 to notify residents of mandatory evacuations (AAR, 2007). Because of the rapid spread of the Guejito Fire, it was not possible to construct and launch a Reverse 911® session prior to arrival of the flames (AAR, 2007). AlertSanDiego was also used and is similarly to the Reverse 911® , however, AlertSanDiego has additional benefits including the ability to dial numbers based on geographic location whereas the Reverse 911® dialed numbers in numerical order. A community access phone system (CAPS) is also available in San Diego to provide a direct information line to the public. During the Cedar Fire of 2003, 12 lines were established for this system, whereas in 2007, this was increased to 20 lines, and operators answered over 12,300 calls.

Communication among Emergency Responders
Communication among emergency responders were improved considerably in 2007 as compared to 2003. Radio communication problems exist in most large scale incidents throughout the nation and include such issues as too many teams assigned to each channel, incompatibility among systems and frequencies, non-essential radio traffic, and in California, an added issue was the limitation of radios due to the terrain. Cell phones, telephones, and satellite phones were used to augment radio communications. In some instances, couriers were used and in other instances field teams used a system of siren tones to alert one another (Campbell, 2004).

By the time the 2007 fires started, San Diego County had improved their communications system such that communication, as reported by responders, had few if any problems. Improvements included availability of the 800 MHZ radios, better use of channels, and integration of WebEOC®, a web-based emergency management communications system, to facilitate internal communications. Incident command guidelines were established and followed in San Diego, and media relations were well managed (AAR, 2007).

Evacuation
The evacuations in 2003 and 2007 were quite different with approximately 100,000 people evacuating in 2003 and more than 900,000 evacuees in 2007. A primary difference in the evacuations was the rapid spread of the 2007 fires. Typically, as in 2003, the Santa Ana winds lessen in the evenings and fire fighters are better able to control as well as predict directions. In 2007, the winds were sustained throughout the evenings. The fire departments involved made decisions based on the best information available, including from fire spotters that are located well ahead of the flames to monitor the spread. Fire departments recommended both mandatory evacuations and voluntary evacuations for areas that could be potentially affected.

The evacuations in most areas began as staged events with voluntary and mandatory evacuation areas identified. Response personnel stated that most fires moved so quickly that the staging became more of a general evacuation. At least five Interstate highways were closed for a period of time during the 2003 fires and two Interstates were closed during the 2007 evacuations. In each incident, the loss of these roadways affected the evacuation. Caltrans, which is the California Department of Transportation, worked with police in helping to establish evacuation routes. This included use of traffic video information to help communicate evacuation congestion. To help alleviate unnecessary congestion, the mayor of San Diego asked that people who did not need to travel refrain from driving during the peak of the evacuations.

The evacuation of pets was very proactive in the 2003 and 2007 fires. In 2007, the San Diego Sheriff's Department mounted patrol assisted with the evacuation of hundreds of horses using department horse trailers when needed. People were encouraged to evacuate their pets, and shelters in many instances accommodated these animals.

Special Needs
In 2007, the special needs population that was evacuated was considerably larger than in 2003. In discussions with response personnel, although it is not desired, when necessary, response

personnel evacuate individuals in their patrol cars and even in fire engines if lives are at risk. In San Bernardino, the Sheriff's Department had to support the evacuation of latch key kids that were left at home while parents were at work. The children were later reunited with parents at evacuation logistics centers. Also in San Bernardino, the local community bus service for the mountain areas ran virtually non-stop to evacuate residents with special needs. The service picked up people who were 'regular' riders and also responded to requests when residents called for assistance.

In San Diego, in general the areas that required evacuations were homeowners with vehicles. There were as many as 11 special facilities evacuated and the residents were taken to comparable facilities outside the evacuation zone or to shelters. There were no reports of lack of transportation resources to support these evacuations.

Response personnel in both San Bernardino and San Diego knew of no reports where people were unable to evacuate due to a lack of means. However, an after action report identified that segments of the local population are under represented in the planning and preparedness process including special needs individuals, non-English speaking, transients, and homeless (AAR, 2007). There was also a lack of Spanish speaking translators (AAR, 2007) reportedly available to support shelter facilities and well as general logistics and interaction with evacuees.

Shelter Facilities

The largest shelter used in the 2007 fires was at QualComm stadium. Because this was a stadium, it was frequently compared to the Louisiana Superdome used as a shelter for Hurricane Katrina. Emergency response personnel very clearly pointed out that there is no basis for any type of comparison. The only common element was that both shelters were stadiums. The evacuees that sheltered at QualComm generally had their own vehicle and could come and go at will. Thus, they frequented restaurants and shopped for basic supplies as needed. Donations of food, water, and necessities poured into Qualcomm almost immediately such that the traffic from these donors contributed to the congestion around the stadium. Thus, there was really no common basis for a comparison to the Superdome.

The City had in fact learned a lesson from Hurricane Katrina on the need to keep people entertained, and the City Parks and Recreation department brought in activities for children. The shelter was established before the Red Cross could support the facility and volunteers were needed. In many cases these included city workers as well as Community Emergency Response Team or CERT volunteers. CERT is a volunteer network of citizens in California that have limited training and are credentialed to support emergency response activities. The CERT teams assisted with many elements of the emergency response most notably interacting with evacuees and supporting needs at shelters. The shelter program in California was very acceptable of pets. Pet shelters were available, and pets were also accepted at many of the evacuee shelters including QualComm stadium.

6.3 Summary

Following the 2003 California fires, State, city and county agencies prepared assessments of lessons learned and needs to improve response and reduce risk in the future. In 2007, another series of fires occurred in California prompting the evacuation of almost ten times the number of

residents that had evacuated in 2003. The evacuation of over 900,000 residents was widely viewed as successful. The implementation of improvements developed from these lessons learned were clearly instrumental in supporting effective communication among responders and the public, facilitating massive evacuations, and sheltering thousands of evacuees.

The insights from the study of these fires do support that implementation of lessons learned can occur quickly and have beneficial impacts on response. In the review of the California fires there were few new lessons learned. The need to plan for the evacuation of latch key children became evident when the San Bernardino Sheriff's Department began receiving calls from parents. Another lesson learned although obvious to the firefighters, was the need to be prepared to respond to wind shifts and changes in direction of the hazard.

From emergency planning around NPPs there is no specific guidance for evacuation planning of latch key children. This is addressed under the broad requirement that planning be in place for the public. With regard to changing direction of the hazard, emergency preparedness around NPPs includes deployment of plume trackers to identify the bounds of the plume. This action as well as expanding the evacuation area, when needed, is tested in large exercises.

7.0 Observations and Recommendations

The extensive research of evacuations conducted for this study provided many insights and lessons learned that will benefit the NRC and / or FEMA emergency preparedness program. Through detailed assessment of 11 evacuations, this study identifies emergency response elements that worked as planned and some that did not work as planned. Within emergency response programs, several important concepts were identified that were clearly associated with improved emergency response, including:

- Regional resources are being integrated into large scale evacuation planning. It was observed that when enhanced traffic management planning for large population areas was integrated among agencies, the evacuation was more efficient.
- Evacuation techniques improve when tested.
- Information provided to evacuees while en route improves an evacuation.
- Enhancements in emergency communications improve response effectiveness.
- A greater awareness has developed for the need to plan for special needs individuals who do not reside in special facilities.

7.1 Observations

This report captures the insights and lessons learned in the case studies and summary assessments herein. Some of these include the following:

1. Evacuations need to have a beginning and an end. Once individuals are removed from an area they need to have a destination with adequate support resources. To accomplish this, emergency response agencies are developing a more regional approach to evacuations.

2. Most of the evacuations studied were staged. Staging of evacuations facilitates movement of individuals in higher risk areas early in the evacuation process. For NPP evacuation planning, the use of staged evacuations is a potential protective action. Communication messages for those that need to evacuate and those that should not evacuate until instructed could be planned ahead of time.

3. The deviations from emergency plans in Hurricanes Katrina and Rita caused problems that rippled through the response and ultimately resulted in consequences that may have been avoided had plans been followed more prescriptively. Decisions that deviate from emergency response planning would not be likely to occur during an emergency for an NPP where plans are exercised routinely. The response oversight and support for an NPP accident is structured to limit the potential for such decisions.

4. The success of emergency response is directly related to the commitment of the local emergency response agencies. It was evident during this research that differences in planning among counties or parishes was frequently dependent on the local commitment of specific emergency management agency. The proactive approach of these agencies is similar to the proactive planning and exercising conducted under the NRC and FEMA NPP emergency preparedness program. The routine frequency of drills and exercises

facilitates regular interaction among agencies and individuals responsible in the event of an NPP emergency.

5. The role and capacity of shelters for special needs individuals is not always understood (FHCA, 2007). Although a shelter may be designated for special needs individuals, not all special needs shelters are fully equipped and staffed for severely dependent special needs individuals.

7.2 Recommendations

It is recommended that the NRC and / or FEMA emergency preparedness program consider planning enhancements that address:

1. Special needs individuals who do not reside in special facilities - Guidance could be developed for identifying the number of individuals, needs of these individuals, and resources required to implement protective actions for this population group, such as specialized transportation.

2. Guidance to accommodate special needs individuals in congregate care centers - Guidance could be established for the accommodation of special needs individuals who may be expected at congregate care centers.

3. Integrating a regional approach to evacuations - Guidance could be established based upon population density whereby traffic management plans for high population density sites would be coordinated with receptor municipalities.

4. Assessment of time needed to implement detailed traffic control plans - Exercises could include assessing the time to implement the traffic control plan including locating materials, transporting materials to control points, and mobilization of resources to man the control points as defined in local plans.

5. Guidance that assures duplicate use is not planned for the same special needs resources, such as number of ambulances for evacuation of special needs facilities - Guidance could be established for review of resources planned for special needs facilities.

6. Communication to evacuees and to the non-affected public to support staged evacuations and mitigate shadow evacuations - Planning guidance for offsite communications could be developed to include messages for staged evacuation of an EPZ and for providing instructional information to residents that are not in affected areas.

7. Consideration of the effect of parents arriving at the school to pick up their children - Planning guidance could be developed to define logistics and traffic management to mitigate any impact of parents picking up their children from school.

8. The need to accommodate pets at congregate care centers - Planning guidance could be developed that better defines the concern of pets at congregate care centers. For instance, pets may be allowed if kept outside or in transport cages, etc.

Emergency preparedness for nuclear power plants (NPPs) has advantages that inherently mitigate most of the potential difficulties experienced in large scale evacuations assessed in this study. The emergency preparedness programs around NPPs include comprehensive coordination of resources, dedicated support services, warning and notification systems, and frequent and thorough cross jurisdictional training. Decision processes are established and tested; communication resources are planned, implemented, and tested; and infrastructure is assessed to understand the potential impacts during an evacuation. Some of the elements of the NPP emergency preparedness were observed during this study. In eight of the incidents studied, the hazard encroached upon one or more EPZs affecting a total of 14 EPZs. Emergency personnel confirmed that response to many of these incidents benefitted from the use of some of these emergency planning elements developed for the EPZs.

The comparison developed in this study of the NRC and FEMA regulatory and guidance documentation affirmed that most of the lessons learned in the evacuations studied herein have been anticipated and are already addressed in existing planning and procedures within the NRC and FEMA framework. The suggested enhancements will further strengthen this well prepared program.

8.0 Glossary

Cable Scroll - A method of communicating to the public through use of a scripted message that is scrolled along the bottom of the television screen.

Clearance Time - The time estimated to evacuate an area or region in response to a hurricane threat.

Congregate Care Center - A facility established as a receptor site for evacuees and used as a shelter facility. The facility is designated to receive evacuees and is usually established to provide limited provisions including food, water, and bedding for time periods of a day or two. Other common terms used to designate congregate care centers are reception centers, evacuation shelters, and relocation centers.

Contraflow - Changing the direction of travel on roadways such that more lanes are directed in the outbound direction away from the hazard. This is usually limited to Interstate roadways but has also proven successful on smaller roadways.

Emergency Planning Zone (EPZ) - A generic area defined about a nuclear facility to facilitate offsite emergency planning and develop a significant response base. The area is about 16 km (about 10 miles) around a nuclear power plant within which extensive emergency planning is developed in accordance with NUREG-0654/FEMA-REP-1, Rev. 1. Although the radius for the EPZ implies a circular area, the actual shape depends upon the characteristics of a particular site (NRC, 1980).

Reverse 911® type systems - Commercially available telephone network systems that are used to call all of the telephone numbers within a selected area and communicate a preprogrammed emergency response notification. The size of the area is determined at the time of the incident and can be quite precise.

Route Alerting - Generally considered the use of emergency vehicles to drive through neighborhoods and use public address systems to notify the residents of an emergency. However, some areas also use the term route alerting synonymous with door-to-door notification.

Shelter - A facility designated to receive evacuees. The facility is usually established to provide limited provisions including food, water, and bedding for time periods of a few hours to a day or two.

Special Facilities - Any facility within which the resident individuals are under the control and supervision of the management. This includes but is not limited to nursing homes, hospitals, prisons, and day care centers. In developing evacuation information for nuclear power plants, schools shall be included in this population segment (NRC, 1980).

Special Needs Individual - Any individual who is unable to comply with an evacuation order without assistance from outside the home. This population group encompasses a wide range of individuals including people who are elderly, those with disabilities or medical conditions, people

with limited English proficiency, people with hearing and sight impairment, and people without access to private vehicles (DOT, 2006). Also included in this group are impoverished individuals, chemically dependent individuals, and individuals with emotional or mental disabilities (DHS, 2006b). The definition should also include minor children who are left home alone (i.e., latch key kids).

Transient population - Individuals who do not normally reside within the evacuation area but are in the area when an evacuation is directed. This includes tourists, shoppers, employees, and any other visitor that is not a resident and not in a special facility.

Transit dependent population - The transit or transport dependent population is identified in NUREG-0654/FEMA-REP-1, Rev. 1, Appendix 4 as permanent residents within an EPZ that do not have vehicles with emphasis that special attention be given those households without automobiles. This population group differs from special needs in that aside from not having an automobile, the population group is assumed to be without need of other assistance.

WebEOC® - A web-based emergency management communications system that facilitates real-time information sharing by linking local, State, and Federal sources together. This internet based tool helps maintain a current and consistent information flow during an emergency.

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APPENDIX A

CASE STUDY REPORTS

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HURRICANE GEORGES - September 28, 1998

Number Evacuated: Approximately 1,200,000
Category: Natural
Specific Type: Hurricane

INCIDENT DESCRIPTION

Hurricane Georges made landfall near Key West, Florida as a Category 2 hurricane on September 25, 1998, and made another landfall near Biloxi, Mississippi on September 28, 1998 with 105 mph winds and a storm surge of approximately 5 meters (16 feet) along Mississippi's Gulf Coast. Many communities along the Gulf Coast evacuated including, but not limited to New Orleans, Louisiana; Biloxi, Mississippi; and Miami-Dade and Monroe Counties, Florida. In response to the hurricane, the Louisiana Superdome was used for the first time as a refuge of last resort. Prior to landfall, there were published concerns on the number of residents that required transportation or had other special needs. For those who attempted to leave, in almost all cases, family or friends were able to provide assistance (USACE, 1999).

The storm system hovered over Mississippi for eight hours flooding large areas. One death was directly attributed to the storm (NHC, 1999). Other deaths were related to the hurricane included an elderly woman who died from heat stress while trying to evacuate from New Orleans, two fatalities from fires caused by candles in areas where power had been lost, and one traffic accident fatality in Florida caused by slick roads. Problems recognized during the response to the storm included an over-reaction to the need to evacuate due to the well-publicized threat, insufficient planning, and limited coordination between various agencies responsible for evacuation (Wolshon, 2001).

History of Emergencies

The regions affected by Hurricane Georges are often threatened by hurricanes, flooding and tornados. The last major hurricane and evacuation experienced in Monroe and Miami-Dade Counties prior to Hurricane Georges was Hurricane Andrew in 1992. The last hurricane which posed a large threat to the city of New Orleans was Hurricane Betsy in 1965, and Hurricane Camille was the last to cause major destruction in Biloxi in 1969. In discussions with emergency responders, Hurricanes Betsy and Camille had become the baseline from which many Louisiana and Mississippi residents measured subsequent hurricane warnings. Although it had been some time between large hurricanes for each of these areas, these cities experience hurricane and tropical storm threats frequently, and the residents are aware of the hurricane hazards in their area.

Emergency Preparedness

All of the affected areas had emergency plans at the time of Hurricane Georges, but not all were current. In Monroe County, Florida, the Comprehensive Emergency Management Plan (CEMP) provides the framework for local officials to respond to multiple types of large scale emergency events including hurricanes. The CEMP details responsibilities of county, city, private and State agencies, and the roles that each are expected to play (Monroe County, 2002). The CEMP also includes annexes and standard operating procedures to guide responses to hurricanes and other events.

In Louisiana, the last hurricane evacuation study had been conducted ten years earlier. Community preparedness activities included planning, training, drills and exercises, and community awareness programs. New Orleans did have an emergency plan, which was used in response to Hurricane Georges.

From approximately 1970-1990, New Orleans and Biloxi experienced a lull in hurricane activity. During this time, the Gulf Coast region experienced a population boom in coastal communities. Emergency plans, models of roadway capacities and other essentials necessary to implement efficient large-scale evacuations had not kept up with this change (Wolshon, 2001). After lessons learned from Hurricane Georges (and Floyd) it was determined beneficial to have the Louisiana Department of Transportation (DOT) involved in emergency planning and response. Prior to these incidents, DOT had only been involved peripherally in the emergency management process. Since Hurricanes Georges (and Floyd), the Louisiana DOT has taken a more active role in the planning, management, and operations of hurricane evacuations (Wolshon, 2001).

Training

Training is provided regularly to emergency response personnel in all of the affected communities. Joint training is also conducted between emergency response and industry, including the nuclear power plants and chemical plants in the surrounding counties and parishes. Training includes planning, tabletop exercises, drills and full scale exercises. At the time of Hurricane Georges, cross jurisdictional exercises for hurricane threats were not often conducted. Other preparedness activities include emergency response exercises, which test the plans for hospital evacuations during hurricanes (Monroe County, 2002).

Public Education

Community awareness to hurricane hazards is very high although large scale hurricanes had not affected some of these areas in decades. Brochures and informational packets are distributed to educate residents of their roles and responsibilities during a hurricane. Information is published in newspapers and presented through other local media on where and how to access shelters. Information is provided in a variety of forms on the hazards of hurricanes and the need to comply with evacuation orders.

EMERGENCY RESPONSE

Decision Making

The governor, mayor and parish presidents and county/parish authorities have the authority to declare an evacuation. Although the governor has authority to order an evacuation, this responsibility is almost always delegated to a local authority, such as the mayor, or county/parish authority (United States, 2006b). Although there had been many years since previous hurricanes, there were no reports identified of issues with decision making in Florida and Mississippi. In Louisiana some parishes ordered mandatory evacuations while New Orleans and others only recommended evacuations.

Communications with Emergency Responders

Senior officials and emergency responders were aware of the approach of the hurricane from local radio and media coverage, as well as preparatory actions in anticipation of the hurricane.

There were no notification problems observed in the research. An emergency operations center (EOC) was opened in each of the affected areas. Communication between field and emergency responders were conducted via radio, cell phone and telephone.

Communication with the Public

The public was notified of the approaching hazard and evacuation orders through a variety of avenues. In preparation for the 1998 hurricane season, public information brochures were distributed highlighting areas vulnerable to flooding, evacuation areas, and tips on how to be prepared for a hurricane (USACE, 1999). Local media were provided hurricane response information early in the season to ensure that consistent messages were passed on to the public.

Recommended, voluntary, and mandatory evacuations were issued by local authorities and announced over local radio and television networks. Law enforcement officials drove through select neighborhoods using sirens and public address systems and went door-to-door in some areas to encourage people to leave high risk areas. Updated information was provided by emergency response agencies to the media outlets and was also posted on websites (USACE, 1999). Residents relied heavily on local radio and television outlets to receive information on the status of the incident. Although many methods were used to communicate, residents living mandatory or recommended evacuation zones frequently reported not understanding whether their home was in an evacuation area (USACE, 1999).

Evacuation

Evacuations for Hurricane Georges initially began in the coastal areas of South Florida when officials recommended those living in mobile homes, low-lying areas, and tourists leave the area. This region is frequently advised to evacuate due to approaching storms. Many residents carefully weigh whether or not they will evacuate depending on the projected forecast of the storm, the recommendations of local and State officials, previous experience, and the advice of family and friends. The response rate to evacuation orders can be attributed to a variety of factors in Florida, including the fact that there are better building codes and some people believe their homes will withstand winds (USACE, 1999). Sometimes residents are not convinced they are in the hazard area, or they are not aware that they live within an area under mandatory evacuation orders.

In Jefferson and Orleans Parish, Louisiana, only about a third of the residents left the area in response to Hurricane Georges, and many of those who did leave waited until 24-30 hours before the projected landfall to evacuate (Howell,1998). The majority of those who evacuated from their homes did not leave the parish, staying with friends or family within the parish. In Jefferson Parish, people were more likely to evacuate if their home was known to be in a flood-prone area and if they had a car. In Orleans Parish, residents identified the recommendation from their mayor as a motivating factor of whether to leave or not (Howell, 1998). According to the Hurricane Georges Assessment survey, 54 percent in Louisiana, 60 percent in Mississippi, 62 percent in the Lower Keys and 22 percent in northwest Florida left their homes in response to Hurricane Georges (USACE, 1999). Of those who did not leave, the majority stated that they felt the storm was not strong enough or did not pose a big enough threat to warrant an evacuation (Howell, 1998).

Construction on outbound roadways contributed to severe congestion along evacuation routes in Louisiana and Mississippi. During the evacuation, the State responded and cleared the construction areas to open both westbound lanes. Other parishes within Louisiana experienced flooding along roadways during the evacuation (USACE, 1999). Experiences from Hurricane Georges showed the need for increased evacuation route capacity, development of systems for faster and more reliable traffic flow, the ability to get reliable traffic information out to the traveler, and the need for better planning and coordination during regional and cross-state evacuations (Wolshon, 2001).

Special Needs

Special needs facilities, including hospitals and nursing homes, were evacuated in response to Hurricane Georges with some patients being airlifted to safety. Approximately 40 percent of households in Louisiana, Mississippi, and the Lower Keys had someone within their household that required some sort of assistance to evacuate (USACE, 1999). About half of these households only needed transportation, while the other half needed special care due to a medical or physical condition. In almost all cases, family or friends were able to provide assistance to those who needed it (USACE, 1999). Plans were not well developed at the time to identify or evacuate special needs populations in Louisiana or Mississippi.

Monroe County, Florida has a long standing registration program for the special needs population which was used to support the evacuation of special needs individuals. Programs such as this help identify individuals who may need assistance in evacuations and identify the level of assistance needed.

Shelters

More than 200 shelters were open throughout Florida, Louisiana, Mississippi and Alabama. Approximately 65,000 people stayed in a shelter during or after the hurricane, and almost 2,500 people were reported as having special needs (USACE, 1999). Many of these shelters were staffed by American Red Cross volunteers. Shelters reported inadequate staffing for special needs individuals, lack of food, water and beds, loss of power and communications, evacuees not going to their designated shelter, and the need for more shelters. The Louisiana Superdome was used for the first time as a shelter of last resort. Around 16,000 people were reported to have stayed in the Superdome. The facility was looted and damaged by those who sheltered, but it does not appear the damage was significant.

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St. Charles Parish Emergency Management
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SOUTHERN CALIFORNIA FIRES, 2003

Number Evacuated: > 100,000
Category: Natural Disaster
Specific Type: Fire

INTRODUCTION

From October 21 through November 4, 2003, Southern California experienced the worst wildland urban fire in the State's history when over 740,000 acres burned, 3,710 homes were destroyed, and 24 people lost their lives (CDF, 2003). This series of fires forced more than 100,000 people to evacuate. The 2003 Southern California wildfires included fourteen different fires the smallest of which burned approximately 100 acres, and the most destructive fire consumed over 270,000 acres (CDF, 2003). As devastating as these fires were, the proactive planning and response of California fire agencies along with support from around the country prevented these fires from causing even greater destruction.

The fire response teams had benefitted from the implementation of improvements that had been initiated due to lessons learned from previous fires. The Incident Command System (ICS), the California Fire Plan, and the National Fire Plan are some of these improvements (CDF, 2003). Additionally, the Forest Service Predictive Services at the Southern Operations Center had closely monitored the weather and fuel conditions and had predicted the Santa Ana wind conditions prior to the fires. Using this information, fire fighting resources were moved to Southern California before most of the large fires had started (CDF, 2003).

A number of complexities differentiated these fires from past fire seasons. Multiple rapidly moving fires were burning concurrently often covering multiple jurisdictions and leading to overlap of some responsibilities (CDF, 2003). This region of Southern California includes some of the most populated areas of the country. San Bernardino, Los Angeles, Riverside, San Diego, and Ventura Counties were all declared Major Disaster Areas.

History of Emergencies

The California Department of Forestry and Fire Protection responds to more than 5,000 fires annually with about 97 percent of these extinguished the first day (CDF, 2003). With this consistent volume of activity, the State of California and the Forest Service have actively progressed in emergency planning and response to fires. In 1993, the Laguna Beach Fire prompted the development of the California Fire Plan, and the State passed the Standardized Emergency Management System Act (SEMS) the same year. The SEMS required the State of California to use a standardized emergency management system from which the Incident Command System (ICS) later evolved.

Some of the communities affected by the 2003 fires had experienced fire-related evacuations in previous years. The Roblar 2 Fire on Camp Pendelton was reminiscent of the 1985 Roblar Fire the experience from which had prepared the Camp Pendelton Fire Department and surrounding communities and facilitated a very aggressive response at the local and Federal level (CDF, 2003).

Emergency Preparedness

The California Fire Plan, National Fire Plan, ICS, SEMS, Multi-Agency Coordinating System (MACS), and other programs were used during the response. All these programs in some way are intended to unify various fire agencies to provide consistent direction and information to responders, policy makers, and the public. The ICS system was developed to facilitate a more efficient response. This system addressed several recognized weaknesses in fire response prior to the 2003 fires, such as identifying a person or persons in charge of the response, having a plan that can expand if an incident worsens, and having trained professionals or incident teams that can be dispatched to a site as single units (CDF, 2003). Prior to the 2003 fires there were more than 50 Fire Safe Councils within the region (Mutch, 2007; CDF, 2003). These Fire Safe Councils are established to help communities prepare for wildfires.

In 2002, the Mountain Area Safety Task Force (MAST) was organized to address public safety and forest issues on private and public lands. The efforts of the task force include intensive pre-planning efforts in San Bernardino and Riverside Counties (CDF, 2003). MAST is one of the most extensive pre-event planning efforts conducted in the region.

Training

Training for fire fighters is diverse and includes many different agencies (Campbell, 2004). Routine training includes drills and exercises that focus on fire safety and response. Private industries including hotel chains, petrochemical facilities, and other large industries conduct joint exercises with fire personnel to prepare both the emergency responder and industry in their roles and responsibilities during a fire.

Extensive training is provided to fire responders, however, after the fires of 2003 it was recognized there were no Statewide initial training standards or maintenance of performance standards (Campbell, 2004). California has led efforts in developing new training programs, but has not brought these together in a coordinated manner. Training programs were not readily available in all areas of the State, and funding for the development of new or existing training programs was not always available. Training programs prior to 2003 were determined by the local fire departments based on local needs and the availability of resources (Campbell, 2004).

Public Education

The communities of Southern California are aware of the fire risk; however, a finding of the Blue Ribbon Report (Campbell, 2004) was that a comprehensive public awareness education program is needed. Through community awareness groups such as MAST, efforts are being implemented to better educate the public of their environment and responsibilities. Forestry and fire departments are now taking a proactive approach to educate the public on fire safety through interactive websites, videos, fact sheets and community group presentations.

EMERGENCY RESPONSE

Decision Making

The relationships that existed among local, State, and Federal agencies provided an excellent example of multi-agency cross jurisdictional cooperation and facilitated decision making. In a State as large and populous as California, cooperative efforts between local, State and Federal

agencies were critical in the response to wildland urban fires (Campbell, 2004). Agencies worked together coordinating assets from neighboring fire stations and State resources.

Political boundaries were constantly crossed during the two-week ordeal. Command, control and coordination processes were pre-planned under the command structure provided by the ICS. It was frequently the responsibility of the Incident Commander or local authorities to issue necessary evacuation orders.

Communications with Emergency Responders

Early in 2003, State agencies had been aware of the drought and fuel conditions that could contribute to fires. The Forest Service had received funding for additional fire prevention patrol units and Predictive Services in Riverside California had been closely monitoring conditions continuously. Senior local officials and emergency responders were generally notified of an incident via local authorities or media coverage. An EOC and several Incident Command Posts were established to respond to the fires. A Joint Information Center was activated on October 27, 2003 and logged an average of 1,450 calls per day (CDF, 2003).

Communications were sometimes difficult among emergency responders in the field. Some local fire departments had radios that were on different frequencies than those used by State or Federal agencies. The 700 MHZ and 800 MHZ radio systems did not often work in mountainous terrain and were not always able to meet the heavy communication demand between firefighting resources. Communication was sometimes limited among 800 MHZ systems if the radios were made by different manufacturers. Incompatible communication systems sometimes made it difficult for strike teams to communicate with commanders resorting to cell phones and two-way radios when available (Campbell, 2004). Cell phone and satellite phone use was limited to areas where signals were available. At times firefighters used fire engine sirens to communicate with nearby engines.

Communication with the Public

The public was generally kept informed on the progression of the fires through television, radio and newspapers. However, these fires moved very quickly and changed direction frequently due to the Santa Ana winds. When time allowed, voluntary and mandatory evacuation notices were provided to residents following standard communication methods. The public was notified of evacuations areas via television and radio broadcasts, and sometimes door-to-door notification by emergency responders and neighbors. Reverse 911® systems, sirens, and public address systems were also methods used to inform the public (OES, 2004). Helicopters flew over some neighborhoods announcing evacuation warnings using loudspeakers (Mutch, 2007).

In spite of the number of methods used, some members of the public expressed disappointment in not having been notified of the need to evacuate or not having sufficient information to make an educated evacuation decision (Mutch, 2007; Campbell, 2004). For example, EAS messages were not consistently used due to the continuously changing situation. Often, emergency responders felt they could give a more up-to-date message if they communicated the information directly to the public. Also, EAS messages were not always used due to the timing of the evacuation. If an evacuation needed to occur during the night, emergency responders recognized that most people would be sleeping and would not receive the message. Thus, going door-to-door or using sirens to notify the public was viewed as the more appropriate

notification method in these instances. A recommendation in the post-action assessment of the fires was for local areas to develop appropriate early warning systems which may include a combination of systems (Campbell, 2004).

In a proactive effort to communicate with the public, the MAST used a JIC to provide mountain area residents and evacuees information during the fires. The center was activated on October 27, 2003 and logged 23,000 calls during the incident. Agency employees and volunteers staffed the center which was available to callers 24/7. Most callers requested information on road closures, lifting of the evacuation, and reentry information (OES, 2003).

Evacuation

Evacuations that occurred as a result of the 2003 California Fire Siege are best described as staged with communities evacuated depending on the changing threat conditions. In some situations, residents were advised to shelter-in-place either because routes of egress were closed, or fire conditions were too dangerous to safely evacuate an area (CDF, 2003). Residents did not always follow instructions provided to them by emergency responders. Some residents left when they had not been advised to evacuate, some chose not to leave, and some evacuated after fire conditions worsened. The fast moving nature of these fires created difficulty in coordinating evacuations and in notifying the public. In some areas, residents had only minutes of notice to evacuate, and as a result, 24 people died (Campbell, 2004), many of whom were in the act of evacuating at the last minute (Mutch, 2007).

The largest single evacuation effort was concentrated in San Bernardino County when 80,000 mountain area residents evacuated (Campbell, 2004). Much of the evacuation was conducted after dark and portions of the affected area were without electricity. Because of previous community awareness programs implemented through the MAST, the evacuation was a success and was completed in only a few hours. Evacuation plans for rural areas in San Bernardino County had included contraflow on some roadways, but these were not implemented (SILC, 2004). When communities were advised to evacuate, the response was generally immediate and congestion became an issue with some traffic backups of 3-4 hours reported on rural roadways (SILC, 2004).

In most of the areas, those who evacuated had access to private vehicles. Sometimes evacuation routes were identified and communicated the evacuees. However, not all areas had pre-planned evacuation routes. Traffic control points were manned during the entirety of the event. There were numerous roads that were cut-off or closed due to fire conditions. At least five major interstates (Interstates 5, 8, 15, 210 and 215) were closed at some time during the fires.

The San Diego County Animal Control facilitated the rescue and shelter of over 3,500 horses and 500 domestic animals. The evacuation of the animals was coordinated with the Sheriff's Department (CDF, 2003).

Special Needs

The State Independent Living Council (SILC) has participated in Statewide disaster planning for many years. Transit for special needs individuals was available in some areas. The Mountain Area Rural Transit Agency (MARTA) evacuated dozens of people with disabilities. This was

successful because MARTA drivers knew where their frequent riders lived (SILC, 2004). Lists of disabled individuals were available in the fire departments, but with firefighters in the field, the office activities were very limited and the disability lists were not accessed.

The fires had a significant impact on lower income families, the elderly, and special needs individuals (OES, 2004). The Governor's Office of Emergency Services identified this as an area where improvement could be made (OES, 2004). There were no reports identified of residents being unable to evacuate because of special needs or lack of transportation.

Shelters

California has a well developed voluntary organization network and in response to the disaster, voluntary organizations opened and operated tens of shelters throughout the area. Residents were typically directed to a local shelter, but most chose instead to stay with friends, family, or in other accommodations. At least 41 shelters and evacuation centers were opened in response to the California Fires and were usually managed by the American Red Cross. Approximately 11,000 people reported to the shelters (FEMA, 2004). Over 1,600 people were sheltered in unused airport hangers at the San Bernardino International Airport and more than 3,000 evacuees were sheltered at Norton Air Force Base (OES, 2004).

Approximately 8,000 families camped out in cars and recreational vehicles in the QualComm Stadium in San Diego which was reported as providing an organized and clean facilities. The facility had been designated an evacuation center, not a shelter, and was closed quickly forcing evacuees to find shelter elsewhere.

In San Bernardino County, residents of two nursing homes were evacuated to a shelter at Norton Air Force Base, but many of the residents evacuated without bringing their mobility aids. Some of these evacuees were bedridden and needed volunteers to carry them to the restrooms when needed. Evacuation planning had not included vehicles that could carry wheelchairs (SILC, 2004).

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HURRICANE IVAN - September 16, 2004

Number Evacuated: Approximately 2.3 million
Category: Natural Disaster
Specific Type: Hurricane

INTRODUCTION

Hurricane Ivan was the strongest hurricane of the 2004 season making landfall near Gulf Shores, Alabama on September 16, 2004 as a Category 3 hurricane. Approximately 2.3 million people were urged to evacuate along the coasts of Florida, Alabama, Mississippi and Louisiana. Hurricane Ivan was the third hurricane to cause an evacuation in little over a month in the Florida Keys with Hurricane Charley having made landfall on August 13, and Hurricane Frances on September 4, 2004.

In Louisiana, mandatory evacuations were ordered in at least six parishes, and voluntary evacuations were recommended in six other parishes. The mayor of New Orleans aggressively recommended a voluntary evacuation of New Orleans; however, only about one third of the New Orleans metropolitan area evacuated prior to the hurricane landfall. The evacuation plan for the area had recently been updated with improvements intended to reduce congestion. The plan, which included the first use of contraflow, was implemented, but severe traffic congestion was still experienced by evacuees.

A notification of an unusual event was declared on September 14, 2004 at Waterford 3 nuclear power plant located within St. Charles Parish. The declaration was due to the issuance of a Hurricane Warning for St. Charles Parish, Louisiana (NRC, 2004a). Waterford 3 sustained no damage to safety systems from the storm and was able to remain at 100 percent power.

History of Emergencies
Louisiana, Mississippi, Alabama and Florida are often threatened by natural disasters such as hurricanes, floods, and tornadoes. Technological hazards are also present due to heavy industry in most of these areas. The Florida Keys had been hit by two other hurricanes in a matter of weeks prior to Hurricane Ivan. In New Orleans, the most recent evacuation due to a hurricane threat had been Hurricane Georges in 1998.

Emergency Preparedness
An emergency plan for New Orleans was available and used in response to Hurricane Ivan. This plan included a section on evacuation, but did not include a means of evacuating the transit dependent population out of the city. New Orleans residents that were unable to evacuate the city were informed they should “vertically” evacuate, meaning to seek shelter in multi-story buildings (CNN, 2004). This would allow them to be above the expected flood level.

In Florida, emergency management had implemented emergency preparedness plans for Hurricanes Charley and Frances in the previous month and were well prepared for Hurricane Ivan.

Training

Comprehensive training is provided regularly to emergency response personnel in all of the affected communities. Joint training is also conducted between emergency response and industry, including the nuclear power plants and chemical plants in the surrounding counties and parishes. Training includes planning, tabletop exercises, drills and full scale exercises. Other preparedness activities include emergency response exercises, which test the plans for hospital evacuations during hurricanes (Monroe County, 2007).

Public Education

Community awareness to hurricane hazards is high due to the frequency in which hurricanes threaten this part of the country. Brochures and informational packets are distributed to educate residents of their roles and responsibilities during a hurricane. Information on the hazards of hurricanes and the need to comply with evacuation orders is provided in a variety of forms at State to local levels. Information was published in newspapers and presented in other the local media on where and how to access shelters. At the time of Hurricane Ivan, the Gulf Coast was aware of the hazards posed by hurricanes and the potential flooding that could occur having just witnessed the impact of Hurricanes Charlie and Frances on the State of Florida.

EMERGENCY RESPONSE

Decision Making

The governor, mayor and parish presidents and county/parish authorities have the authority to declare an evacuation. Although the governor has authority to order an evacuation, this responsibility is almost always delegated to a local authority, such as the mayor, or county/parish authority (United States, 2006b).

Local authorities of some areas, including New Orleans, had desired for contraflow to be established, but implementation was delayed until State Police were available to man traffic control sites. Multiple evacuation routes used were merged near Baton Rouge, Louisiana. There had been no coordination with Baton Rouge authorities on managing the evacuation traffic. As a result, the evacuation traffic combined with the normal daily flow of local traffic resulted in congestion around the Baton Rouge metro area.

In Alabama, contraflow was implemented on Interstate 65. Although the traffic volumes observed did not warrant use of contraflow, decision makers demanded its implementation. Contraflow was used for about 10 hours, but traffic counts at the time suggested that the main evacuation surge was already over. Although the use of contraflow may not have been necessary, the implementation experience will prove beneficial in the future.

Communications with Emergency Responders

Senior officials and emergency responders were well aware of the approach of the hurricane from local radio and media coverage, as well as preparatory actions in anticipation of the hurricane. There were no notification problems identified in the research. An EOC was opened in each of the affected areas. Communication between field and emergency responders were conducted via radio, cell phone and telephone.

Communication with the Public

Evacuation information was provided to the public through a variety of outlets in the days prior to landfall. These included local news media coverage, radio broadcasts and newspaper reports. Hurricane evacuation information was provided by local officials primarily through these media outlets. In some areas, door-to-door notification was provided to residents.

Post-storm reports identified that there were “mixed” evacuation messages communicated to the public (Wolshon, 2005). One hindrance to the evacuation was the time frame in which evacuation orders were issued. Many evacuation notifications were distributed on Tuesday; however, people were still expected to report to their work places on Tuesday and Wednesday. This is believed to have caused many people to leave later than they would have otherwise.

Evacuation

In Florida, evacuation orders began as early as September 9, 2004 when officials instructed tourists and residents in low-lying areas and mobile homes to leave the Florida Keys. This was the third visitor evacuation of the Keys within a four week period. Although many did evacuate, some decided not to leave until the projected path of the storm was more certain. Two days later, mandatory evacuations were ordered for the Charlotte County barrier islands and mobile home parks. Authorities reported that many residents had already evacuated before the initial order was given. Some residents, having experienced the recent hurricanes, spontaneously evacuated as soon as Hurricane Ivan appeared to be a threat.

On September 13, 2004, the path of Hurricane Ivan shifted direction but still had a cone of probability to make landfall between Florida and west of New Orleans. In Mississippi, residents living south of I-10 were under a mandatory evacuation order. In a survey of the four States affected, virtually every county emergency management office reported heavy traffic and gridlock as characteristic of the evacuation (USACE, 2005). The State of Mississippi had planned and used officers from many different State agencies to support the traffic control. Although the State was ready to respond, traffic congestion was not anticipated as early as it had occurred. In discussions with emergency responders, traffic congestion was heavy in Mississippi.

Residents trying to evacuate from New Orleans were also stuck in traffic, with some evacuees taking more than 36 hours to reach their destination. A new contraflow plan had been developed, and although the plan had been modeled, Hurricane Ivan was the first time the revised plan had been implemented. Contraflow was implemented to alleviate the growing traffic congestion but bottlenecks were created at loading and unloading points on the route. There were new lessons learned on the placement and timing of equipment and the need to include a regional approach in planning.

The evacuation for Hurricane Ivan was considered successful by many in the emergency response community relative to previous evacuations. More than twice the number of residents were able to evacuate New Orleans in response to Hurricane Ivan compared to Hurricane Georges. Officials, working with traffic engineers and planners, realized after Hurricane Ivan that contraflow should not be used to fix congestion after it occurs, but rather, should be implemented before traffic congestion escalates. In New Orleans, two special needs patients died while stuck in evacuation traffic.

Special Needs

In Louisiana, there were limited plans in place to identify special needs individuals who may have difficulty leaving. Few parishes had established plans or outreach programs to identify this population group and develop transportation plans. Furthermore, at the time of Hurricane Ivan, the special needs population would have generally been defined as individuals with health problems or physical constraints that would keep them from evacuating. In 2004, transit dependent individuals were not generally considered special needs.

Shelters

Shelters for evacuees and special needs individuals were opened in every affected State. Even with the large number of shelters, many evacuees displaced by Hurricane Ivan found it difficult to find shelters or hotels with vacancies. Hotels as far north as Memphis, Tennessee were at full capacity. In Baldwin County, Alabama, shelters were unable to be opened because projected winds were too high.

The 2004 hurricane season was the first major test of the Florida shelter system since 1995 and more than a thousand public shelters were opened during the season, with 88 designated for special needs (SERT, 2005). Although improvements in the shelter programs have advanced in all of the States affected, common issues included shortages of supplies, lack of security and overcrowding. In Monroe County, Florida, officials had said that no shelters would be open in the Florida Keys prior to the storm due to increased area hazards. Also in Florida, some shelters could not be opened as a result of damage sustained from Hurricanes Charley and Frances.

New Orleans residents were advised to find their own shelter in multi-story buildings. The Superdome had been opened as a shelter of last resort on September 15, 2004. Only 1,100 people sheltered at the Superdome during Hurricane Ivan, with 300 National Guardsmen providing security (Southern Digest, 2004). The New Orleans School System opened 10 facilities to be used as shelters and informed evacuees they these shelters were intended to only provide a roof over their heads and no other services. Additional facilities used as shelters included schools, universities, churches, sports arenas, and even a performing arts center.

In Florida, Alabama, Mississippi, and Louisiana, shelters were established for special needs individuals. In some of the affected counties and parishes, transportation was provided, but in many instances, these individuals needed to provide their own transportation to the shelter.

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CHEMICAL FIRE , Romulus, Michigan - August 9, 2005

Number Evacuated: Approximately 3,000
Category: Technological
Specific Type: Chemical Fire

INCIDENT DESCRIPTION

On the evening of August 9, 2005, a chemical recovery plant in Romulus, Michigan caught fire when a hazardous waste tank exploded. Workers heard noises and smelled a solvent, and evacuated the site according to the site evacuation plan. Local and neighboring fire officials and hazmat teams immediately responded to the incident. After assessing the fire, response teams decided to let the it burn rather than apply water on the fire. After the fire died down, it was extinguished by the firefighters. A voluntary evacuation of 0.8 km (one-half mile) around the plant was implemented, and approximately 3,000 people were ordered to evacuate. Those in the surrounding area immediately outside of the evacuation zone sheltered in place and were asked to close windows and doors and turn off air conditioners (National Response Center, 2005).

On August 11, 2005 Romulus city officials lifted the evacuation order after health assessments concluded the area was safe for reentry (HHS, 2006). Approximately 20 people had been treated at the hospital for breathing difficulties and burning throats (National Response Center, 2005). In discussions with emergency management, personnel confirmed an initial concern that the accident may have been initiated by terrorists, but the concern was quickly alleviated.

History of Emergencies
The chemical facility is located approximately 24 km (15 miles) southwest of Detroit in Romulus, Michigan, near the Detroit Metropolitan Airport. There is a high density of chemical and industrial facilities in the area. The community had not experienced a severe incident with these hazards and has not been involved in a recent evacuation.

Emergency Preparedness
Emergency planning information is available through the City of Romulus Local Emergency Planning Committee. Romulus is one of 97 emergency planning districts in Michigan. The Romulus Emergency Management department incorporates plans, response and recovery actions for all hazards. Emergency Management coordinates activities with local, county, State, Federal agencies, and schools, private and public business (City of Romulus). As of 1997, Romulus, Michigan had over 170 facilities registered with the EPA for hazardous waste handling (Ecocenter, 2005).

Training
Emergency responders are regularly involved in training exercises and drills. Some of these drills include joint training between industry and government agencies. A variety of drills are conducted from table-top exercises to full-scale drills. The full-scale drills generally occur on an annual or bi-annual basis.

Public Education
The community affected by the evacuation is in an area densely populated with industrial facilities. Emergency planning information is available through the City of Romulus web site and through the Local Emergency Planning Committee (LEPC). No recent evacuations had occurred in this area and residents had little experience with alerting methods, but this did not affect the success of the evacuation.

EMERGENCY RESPONSE

Decision Making
The decision to evacuate was made by local emergency response authorities. The command and control process was implemented in accordance with the emergency response plan. According to the existing plans, the local fire chief was head of incident command. The response involved local agencies from surrounding cities and towns. After the incident, city officials acknowledged the efforts of the firefighters and police within the communities as an example of how mutual aid can work effectively.

Communications with Emergency Responders
Senior officials were notified of the incident after the emergency call was received by 911 operators. To support the response, a mobile command post was brought in, and all decisions were coordinated from this location. There were no problems encountered with notification of senior officials or emergency responders. Communications between field emergency responders and the EOC were primarily conducted over radios and cell phones. Typically cell phones were used to communicate to officials and department heads who were located offsite, and radios were used in the field.

Communication problems resulted when various agencies used different radio frequencies. Some used an 800 MHZ system, while others used UHF radio. Emergency responders using these different radios could not communicate with each other and had to augment communications with cell phones.

Communication with the Public
Police and firefighters went through the neighborhoods within a 0.8 km (one-half mile) radius announcing the evacuation via loudspeakers and also went door-to-door to inform residents in some areas. The fire department only issued an order to evacuate a 0.8 km (0.5 mile) radius; however, the media broadcast a 1.6 km (1 mile) radius for the evacuation area. Because the area was larger and the additional evacuees were not affecting the response, the fire department did not attempt to correct the error. In the days following the explosion, officials communicated event status, hazards, and reentry information to the public predominantly through media outlets, including television and radio broadcasts and newspaper articles. Only a few residents outside the evacuation area were reported to have evacuated.

Evacuation
A voluntary evacuation was ordered for households within a 0.8 km (0.5 miles) radius of the chemical plant. This evacuation order encompassed approximately 3,000 people. Many of the residents that evacuated were not aware of the close proximity of the plant to their homes (Ecocenter, 2005). Those who remained in the surrounding areas were asked to stay inside,

close windows and doors, and keep air conditioning units off. Residents rapidly evacuated the area and were not allowed to re-enter the area to retrieve belongings for two days. According to Romulus police, as residents were informed of the need to evacuate, and residents were informed of the location of available shelters.

Police and fire personnel drove through some neighborhoods to verify that residents had evacuated. Traffic control points were established and manned during the entirety of the event. Barricades were put up to keep people out of the area, but it was reported a few individuals went around the barricades and returned.

Special Needs

There were no special needs facilities in the area covered by the evacuation order, but ambulances were used to evacuate some special needs individuals out of the area. There were plans in place to use school buses to evacuate people that did not have transportation, but there were no reports of these being implemented. The City of Romulus website provides instructions for residents who lacked transportation out of an area to ask a neighbor for assistance. If a neighbor was not available, instructions were to listen to the emergency broadcast station for further information.

Shelters

Residents were informed that shelter was available at the Romulus High School and Wayne Memorial High School, which were located less than 5 km (about 3 miles) from the chemical facility. Residents were not provided specific directions to the shelter locations because residents are familiar with the area. City personnel from Romulus and Wayne, Michigan as well as the American Red Cross and Salvation Army, managed the shelters. The American Red Cross was able to assist both shelters very quickly.

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HURRICANE KATRINA – August 29, 2005

Number Evacuated: Approximately 2 million
Category: Natural Disaster
Specific Type: Hurricane

INTRODUCTION

Hurricane Katrina made landfall on August 25, 2005 in southern Florida as a Category 1 hurricane. The hurricane intensified and made a devastating second landfall near Buras, Louisiana on August 29, 2005 as a Category 3 hurricane (NHC, 2006). Hurricane Katrina was approximately 640 km (400 miles) across prompting the evacuation of approximately 2 million people along the Gulf Coast from Louisiana to Florida. The evacuation was generally considered successful (United States, 2006a).

A few hours after landfall, the levee system surrounding New Orleans failed and approximately 80 percent of the city flooded. In some areas, the depth of flooding exceeded 6 meters (more than 20 feet). A massive search effort ensued to rescue those who had not evacuated the area prior to landfall. Approximately 1,800 people lost their lives, with only one death attributed to the pre-landfall evacuation (Times - Picayune, 2005). Approximately 75 percent of those who died more than 60 years old (United States, 2006b). In the days following landfall, local, State and Federal government response agencies were tested to their limits.

The New Orleans devastation occurred after the levee system failed. In Mississippi, eastern Louisiana, and Alabama, it was the hurricane force winds and storm surge that devastated the region. At landfall, the Mississippi coast experienced 155 mph winds and a storm surge of about 10 meters (about 34 feet) that swept inland (United States, 2006a). Half of Mississippi was left without power, and high winds and tornadoes generated by the storm left thousands homeless. The communities of Bay St. Louis, Waveland, Pass Christian and others were heavily damaged. Hurricane Katrina turned 60 percent of the State of Mississippi into a catastrophic disaster area. Two hundred and thirty one people from Mississippi were killed by the storm and more than 200,000 were displaced (United States, 2006a). As reported in the Federal Response to Hurricane Katrina (2006b), approximately 75 percent of those who died were more than 60 years old. In discussions with emergency responders in Louisiana and Mississippi, many residents who did not evacuate during Hurricane Katrina had lived through Hurricane Betsy or Camille and believed that Hurricane Katrina could not be as devastating.

This hurricane presents a very complex study in emergency preparedness and response. Hurricane Katrina was the first United States disaster to ever exceed $100 billion in damages (USACE, 2007). Over 300,000 homes were either destroyed or left uninhabitable and over 100 million cubic yards of refuse was generated (United States, 2006b). The collection and disposal of the tremendous amount of debris was identified as one of the largest and most unexpected issues encountered by St. Charles parish emergency responders. Communication systems were crippled in the days following landfall.

The Waterford 3 nuclear power plant located in St. Charles Parish, Louisiana received minimal damage from localized flooding and incurred no damage to safety systems. Preparations at Waterford 3 began on August 26, 2005, with twice daily meetings with St. Charles Parish emergency management. Loss of offsite power occurred on August 29 and was not restored until September 2, 2005.

History of Emergencies

The Gulf Coast States have experienced numerous natural and technological disasters including hurricanes, tropical storms, flooding, tornadoes, and chemical incidents. The region is often threatened with the possibility of hurricanes. New Orleans had evacuated in 1998 in response to Hurricane Georges and in 2004 in response to Hurricane Ivan. However, the city had not experienced a catastrophic hurricane since Hurricane Betsy in 1965. The State of Mississippi had also ordered evacuations in response to Hurricane Georges in 1998 and Hurricane Ivan in 2004, but had not been seriously affected by a hurricane since Hurricane Camille in 1969. These two hurricanes, Betsy and Camille had become benchmarks for many longtime area residents.

Emergency Planning

New Orleans has long been identified by emergency planners as susceptible to severe flooding from hurricanes due to large areas of the city located below sea level. The city had most recently been evaluated in the Hurricane Pam exercise in 2004. The implementation of lessons learned from the Hurricane Pam exercise was incomplete, but for those activities where lessons learned were implemented, improvements over previous hurricane evacuations were evident. State transportation officials had revised the State contraflow plan based on lessons learned during the Hurricane Ivan evacuation a year earlier. This was a key factor in the successful evacuation of Louisiana.

The Louisiana Office of Homeland Security and Emergency Preparedness prepares and maintains a homeland security and emergency operations plan, which establishes the policies and structure for the State's management during emergencies and disasters (United States, 2006a). Emergency operations are first managed at the parish level. If local authorities become overwhelmed, overextended, or overtaxed, State emergency management agencies are required by law to take authority. Similarly, if State agencies become overwhelmed, Federal agencies are requested to assist in the response efforts.

The City of New Orleans Comprehensive Emergency Management Plan (2005) provided for the use of all available resources to evacuate threatened areas, and identified that special arrangements would be made to evacuate persons unable to transport themselves. The plan identified the need to evacuate approximately 100,000 citizens of New Orleans who do not have personal transportation. However, these measures were largely ineffective do to a lack of detailed planning to manage the key operational aspects of such a scenario.

The State of Mississippi and local communities, such as Gulfport, Biloxi, and Pass Christian, implemented their emergency plans. The Mississippi Emergency Management Agency (MEMA) had been using Federal grants to fund improvements in emergency plans (United States, 2006a)

Alabama authorities had implemented lessons learned from Hurricanes Dennis and Ivan and had practiced to reduce the time needed to implement contraflow. Also, Alabama implemented a proactive communications strategy which was a key element in the response. The governor of Alabama had visited all of the Gulf Coast counties prior to landfall urging residents to evacuate in accordance with mandatory evacuation orders (United States, 2006a).

Training

Training is provided at State and local levels throughout Louisiana. A minimum of one full-scale exercise, which includes the mayor, elected and appointed officials, independent authorities and non-governmental agencies, is conducted in New Orleans annually. Coordinated training is conducted annually with the State, and exercises and drills are conducted annually among emergency responders and many private industries.

In Mississippi, the State recommends local emergency response plans be tested and exercised annually. In early 2005, over 1,200 first responders in Mississippi received training in the National Incident Management System (NIMS), which contributed to the ability to quickly present a unified front during Hurricane Katrina (United States, 2006a). MEMA offers numerous training exercises for State and local emergency managers, public officials, members of volunteer relief organizations and professionals. The MEMA training program provides a way to train State and local officials in disaster mitigation, preparedness, response and recovery. Jurisdictions across Mississippi prepare in advance through training activities and by using the skills learned, to build local teams that respond to emergencies. Coordinated drills and exercises are conducted among local and State agencies. A full-scale EOC at the State level is activated at least annually.

Public Education

At the start of the hurricane season, there are many opportunities for the residents along the Gulf Coast to receive information on the threat of hurricanes. These include local television and radio broadcasts, newspaper articles, and websites. The Louisiana DOT also conducted a public information campaign which included civic meetings, news media announcements, and the distribution of contraflow maps and directions at local stores and gas stations. The New Orleans Comprehensive Emergency Management Plan identifies the need for public education and includes discussion on developing media for those that do not use traditional media (New Orleans, 2005). Brochures are mailed out in many counties and parishes. The emergency awareness brochure for Plaquemines Parish had been completed and was distributed to residents only a couple of weeks before Hurricane Katrina (St. Amant, 2007).

Mississippi, Alabama and Florida coastal communities have had several hurricane evacuations in the last 10 years, which contributed to public awareness. The Gulf Coast States plan for a staged evacuation, and residents are provided information on which areas evacuate in a specified order. The Mississippi Comprehensive Emergency Management Plan includes discussion on preparedness and dissemination of public information packages. Also in Mississippi, responders such as local fire chiefs make frequent educational presentations to schools and civic groups to maintain awareness of the public.

EMERGENCY RESPONSE

Decision Making

Before the landfall of Hurricane Katrina, local, State and Federal agencies coordinated fairly well together. The decisions to evacuate were made by local officials and were often coordinated with neighboring parishes and the State. While many parishes in Louisiana and counties in Mississippi and Alabama were evacuating under mandatory orders, the City of New Orleans had only issued a voluntary evacuation order. According to the City of New Orleans Comprehensive Emergency Management Plan (2005), it is the responsibility of the mayor to order an evacuation. The delay in ordering a mandatory evacuation contributed to the consequences as identified in the Failure of Initiative (2006a) which states "the incomplete pre-landfall evacuation led to deaths."

In Mississippi, assistance and coordination with Florida emergency responders prior to landfall proved highly beneficial. The law in Mississippi provides the governor authority to order an evacuation, although longstanding practice is to give that responsibility to local authorities. When evacuation decisions are made, these are communicated to State agencies who implement evacuation elements such as traffic control and contraflow. Evacuation orders were made by local mayors or appropriate authorities in the response to Hurricane Katrina.

Political boundaries were crossed at all levels of government, which is normal for any hurricane response. In St. Charles Parish, Louisiana, the Parish President evacuated the public works staff to a coordinated location just outside of the hazard area. Once the hurricane had passed, the public works staff were then in place with the necessary equipment to facilitate reentry into the area. Reentry requires, among other things, clearing roadways of fallen trees and debris to allow traffic movement. Having the foresight to pre-position public works staff and equipment expedited the reentry activities and assured a fully equipped and available public works staff to begin post-incident assessments and repairs to infrastructure. In Mississippi, some emergency response staff were allowed to evacuate, but after the passing of the hurricane many were unable to return.

Communication with Emergency Responders

Senior officials and responders were aware of the approaching hurricane days prior to landfall and initiated proactive communications among responders and with the heavy industry partners in the region. The communication among field response teams was well planned and executed. Communication among coastal and inland counties and parishes were well coordinated and facilitated a staged evacuation of these areas. Routine conference calls to local emergency management agencies and EOCs started as early as August 25, 2005, and the Louisiana State EOC was activated on August 26, 2005. Communications between the EOC and field responders prior to landfall was conducted via conference calls, e-mail, telephones, cell phones, and radio transmissions.

After landfall, many communication avenues were lost. Satellite phones, radios and couriers were used as means of communicating until telephone systems could be repaired. Radio communication was severely impaired due to the hurricane and flood damage. The Mississippi Federal Coordinating Officer testified that communications were far below what was needed to

be effective in the post-hurricane response (United States, 2006a). Thirty-eight 911 call centers were out of service and local wireless networks were severely damaged (United States, 2006a).

Many first responders could only communicate with each other through limited radio availability and satellite phones (United States, 2006a). First responders trying to communicate over radio transmissions had to wait for long periods of time to send messages because there were only two radio channels available. Satellite communications were intermittent at best due to high winds, incomplete signals, and the lag time that occurs when using a satellite phone. Responders sometimes complained about problems operating satellite phones, but some of these complaints are likely due to the operator not fully understanding how to use the satellite phones.

Communication with the Public

The public was notified of the approach of Hurricane Katrina days in advance of landfall through local and national media. The National Hurricane Center disseminated warnings and hurricane forecasts via the National Oceanic and Atmospheric Association (NOAA) weather radio and the internet, operating in conjunction with the EAS (United States, 2006b). Pamphlets were handed out in many areas instructing residents on the order they were to evacuate during staged evacuations. Residents in mobile homes, along waterways, and those in lower elevation areas were encouraged to evacuate early. Instructions on what to bring and which roadways to use were communicated to residents in the days leading up to a hurricane evacuation.

Local news stations, radio stations, cable television, and national TV stations broadcast the voluntary and mandatory evacuation orders issued by officials. The most common form of notification was through the media. All parishes and counties used media to inform the public and some had law enforcement personnel go door-to-door and drive streets in select areas using loud speakers to notify residents of mandatory evacuation orders. St. Charles Parish has its own television station, website and radio station that provided up-to-date information. St. Charles Parish also used the siren system for the Waterford 3 nuclear power plant in their efforts to notify the public. During the evacuation, message signs were provided along the evacuation routes to inform evacuees of current traffic and storm conditions.

In New Orleans, some information was communicated in Spanish and Vietnamese, while in Florida some information was published in Spanish, French and German. There were few reports of real time communication in a non-English language being presented through major local media broadcasts, although one report was found where a local news station in Mississippi presented information in Spanish.

In the days and weeks following Hurricane Katrina, information was communicated to residents and evacuees through web sites and national and local media outlets. Evacuees were able to contact FEMA and the American Red Cross for assistance. Databases with information on missing persons, pet shelter information, reentry information, road conditions and other essential information were available, but sparsely populated. The damage to communication systems throughout the region limited the ability to convey information, which frustrated individuals in their attempts to locate missing persons and obtain information on their homes. Due to the size of the affected area, the extent of damage and the number of evacuees, it

remained difficult to obtain information for many months.

A post-evacuation survey of Hurricane Katrina evacuees (Kaiser, 2005), reported that of those who chose not to evacuate, 73 percent heard the evacuation notification, and 25 percent reported that they did not hear the message. Of the 25 percent who did not hear the notification, 19 percent said that although they did not hear the evacuation message, they were aware that an order had been given for their area. Sixty-six percent said that the evacuation notice provided was clear (Kaiser, 2005).

Evacuation

On August 28, 2005, Hurricane Katrina had strengthened to a Category 5 storm, and the National Weather Center issued a very descriptive warning in an effort to emphasize the high risk of this hurricane and help persuade residents to evacuate. The notice stated among other things that the majority of industrial buildings will become non-functional, airborne debris will be widespread and may include items such as household appliances and light vehicles, people and pets exposed to these winds will face certain death if struck, and most of the area will be uninhabitable for weeks (United States, 2006b). Although fear tactics are not usually considered the best way to influence people, this message did help convince some people to evacuate that may not have done so otherwise.

The evacuation of the general population was one of the largest emergency evacuations in United States history and was generally considered successful in terms of regional traffic management (United States, 2006a). Many of the issues with evacuation were related to decisions to evacuate and the ability of residents to comply with the evacuation orders. For those who wanted to and could leave, the evacuation was better than previous evacuations. The research for this study only identified one death in Louisiana that was directly attributed to the evacuation. A nursing home had evacuated the day before Hurricane Katrina made landfall, and during the 12 hour bus ride an elderly nursing home resident died (Times - Picayune, 2005).

Mississippi

During the days prior to landfall, MEMA conducted extensive planning sessions to develop an EOC activation timeline, as well as plan for protective actions and proactive response. Contacts with FEMA were made and the public was encouraged to begin preparing for the storm (United States, 2006a). Mississippi's National Guard was activated and the governor of Mississippi declared a State of Emergency on August 26, 2005. On August 27, 2005, MEMA activated its State EOC, and county liaisons were deployed to Jackson, Harrison, Hancock, Pearl River, Stone, and George Counties. The State Emergency Response Team was deployed to Camp Shelby. The Governor of Mississippi implemented the contraflow plan on I-55 and I-59 which was a measure that was primarily to assist the State of Louisiana evacuation.

The evacuations were generally staged, with lower-lying areas, mobile home owners, and residence along waterways encouraged to evacuate prior to those in safer areas. Evacuations of Hancock, Harrison and Jackson Counties proceeded well with approximately 400,000 people evacuating. In efforts to encourage people to evacuate out of the area, MEMA urged coastal cities to not open shelters. In discussions with emergency responders in Mississippi, many motorists ran out of gas during the evacuation. There were limited plans in place in Mississippi

to evacuate individuals who were transit dependent, and in many areas there were no plans to support this population group.

MEMA recognized the need for teams of specialized professionals to support post-hurricane response. A lesson learned was to have these teams organized, equipped, credentialed, and trained prior to an incident. Mississippi officials indicated that it is very difficult and time consuming to do this after the incident.

Louisiana

Many parishes within southern Louisiana recommended residents start evacuating early in response to Hurricane Katrina (United States, 2006a). The mayor of New Orleans recommended a voluntary evacuation for the communities of Algiers, the Lower 9th, and other low-lying portions of the city. Despite announcements of hurricane watches and warnings, many residents appeared unaware or unconcerned about the storm (United States, 2006b). On August 27, 2005, Plaquemines and St. Charles Parishes ordered mandatory evacuations within their parishes. In discussions with emergency operations managers, these two parishes coordinated their evacuations with each other so that residents in Plaquemines Parish, which is closer to the coast, could start evacuating before St. Charles residents.

The Louisiana evacuation plan had been updated in 2004 after the evacuation for Hurricane Ivan. The updated plan included a staged evacuation and an improved contraflow plan, which was prepared and implemented in less time than expected (United States, 2006a). State Police were deployed to assist with the evacuation, and traffic volume and rate of flow began to be monitored in the EOC. It was estimated that approximately 92 percent of the threatened population in Louisiana had evacuated (United States, 2006b). According to traffic count data collected from routes close to New Orleans, traffic flow had dropped to a “trickle” about 8 hours prior to storm landfall, suggesting everyone with the means and desire to evacuate had done so. In New Orleans it was estimated that only about 80 percent of the population actually left, leaving close to 70,000 people still in the city (United States, 2006a).

Following the mandatory evacuation order for New Orleans on August 28, 2005 the Regional Transit Authority began running special services from twelve sites across the city to take evacuees to the Superdome and later take special needs persons on to Baton Rouge (United States, 2006a). In the afternoon, conditions had reached a point that all flights in and out of New Orleans airport were canceled and contraflow operations ceased due to high winds.

In the days following landfall, a massive search and rescue operation was conducted to evacuate survivors. Approximately 63,000 people were rescued in New Orleans through the efforts of the National Guard, Fish and Wildlife Service, United States Coast Guard and other agencies. In post-incident surveys, 56 percent of the population who did not evacuate from New Orleans stated that they could have found a way to leave before the storm hit (Kaiser, 2005). In many victim’s homes, cars were found left in the driveway (Untied States, 2006a). Also, in discussions with individual evacuees, many of those that did not evacuate had a practical reason for not evacuating. A common reason for not evacuating was belief that the storm would not be as bad as publicized. About one-third of those who did not evacuate reported lack of money as the reason (Kaiser, 2005).

Special Needs

An element of the Hurricane Katrina response that received a large amount of media coverage was the evacuation of the special needs population. The lack of a formal definition of "special needs" among emergency management officials contributed to the issues associated with evacuating this population group. Special needs individuals, as defined in the Catastrophic Hurricane Evacuation Plan Evaluation (DOT, 2006) included people who were elderly, those with disabilities or medical conditions, people with limited English proficiency, people with hearing and sight impairment, and people without access to private vehicles. Special needs individuals can also include those who are impoverished, chemically dependent, and those with emotional or mental disabilities (DHS, 2006). Although planning for hurricanes was thorough along the Gulf States, none of the emergency response plans in the region included such a broad definition of this population group.

Mississippi

In Gulfport, Mississippi, arrangements were in place to use school buses to transport the special needs population to area shelters. The system was effective in getting people to a safe location. Arrangements were also in place with an ambulance service to transport those who were non-ambulatory. Prior to the evacuation, a special needs list had not been fully compiled through local agencies; however, the ambulance service had its own list, and the county was able to use it to identify some of the special needs individuals. There were no plans in place to evacuate individuals who were transit dependent. These individuals needed to make arrangements for transportation to shelters and in many cases called 911 to request assistance. The police and fire department responded to requests until the hurricane force winds were too hazardous. In Hancock, Harrison and Jackson counties, only a small percentage of the population is dependent on public transportation. These people were encouraged to make evacuation arrangements with friends or family if possible. Shelters were opened in the area for those that were unable to evacuate.

Louisiana

Following the mandatory evacuation order of New Orleans on August 28, 2005, police and fire department personnel were sent through the city asking people to go to checkpoints where buses would pick them up to take them to the Superdome (United States, 2006a). Approximately twenty buses were used to support this effort (United States, 2006a). There were no signs posted with instructions on where to meet buses, and residents found it difficult to know where these checkpoints were. There were no plans for individuals who could not get to a checkpoint.

In Plaquemines Parish, the emergency management department sends out special needs registration information via newspapers, cable television, and local television networks. Twenty-four residents had registered in Plaquemines, and thirty people ultimately required assistance evacuating. The parish Office of Homeland Security and Emergency Preparedness recognizes the time consuming and safety sensitive issues of this population group and conducts very detailed planning. This includes using public health announcements combined with extensive outreach efforts to have people register with the parish. Home visits are made to each applicant, and their condition and needs are verified. This has proven very effective in preparing for evacuations (St. Amant, 2007). The Plaquemines Parish President and

Emergency Management Agency took a very proactive approach getting people out of the parish.

St. Charles Parish, Plaquemines Parish and others had also proactively planned for the evacuation of their special needs populations. Those with special needs were encouraged to self-identify with the parish if assistance was expected to be needed during the evacuation. In St. Charles Parish, a card was sent out each year to identify those who cannot evacuate for health reasons. The parish emergency management agency typically receives about 95 cards each year. St. Charles residents were instructed to call the Emergency Management office, and a bus picked them up from their homes and transported them to a local park where they were evacuated from the parish. Approximately 800 people requested such assistance during Hurricane Katrina (St. Charles Emergency Management).

Nursing home managers and owners prefer to shelter in place during a hurricane and as a result, approximately 70 percent of nursing homes did not implement evacuation procedures (Schlenger, 2006). Evacuating a nursing home may be a risky to the residents well being and is very expensive, requiring special transportation arrangements for ambulances and specialized busing. This cost is not refunded to a nursing home owner if a hurricane shifts course and misses an evacuated area. Therefore, the decision to evacuate a nursing home is often made late in the event, when in fact, the decisions are better made early, because it takes much more time to evacuate special needs facilities.

Sixty to seventy nursing homes were affected by Hurricane Katrina. The Louisiana Department of Health and Hospitals had established seven special needs shelters which quickly became overwhelmed (Schlenger, et. al., 2006). According to the Louisiana Nursing Home Association, licensed facilities are required to have an emergency plan. The development of individual evacuation plans resulted in facilities identifying the same local busing and ambulance resources to support an evacuation. This planning practice resulted in a lack of resources. Only 21 Louisiana nursing homes evacuated prior to hurricane landfall (LNHA, 2006). Buses that been contracted were not always available (Schlenger, 2006), and residents had to travel in borrowed vehicles that sometimes lacked air-conditioning or broke down along the way. Trips took longer than expected and food and water were sometimes rationed. Medicine, oxygen tanks and incontinence supplies were often left behind. Thirty-six additional facilities were evacuated post-landfall, but these nursing homes and hospitals were not a priority during the rescue process (LNHA, 2006). As a result of poor planning, bad decisions and unfortunate circumstances, over 200 nursing home patients died as a result of Hurricane Katrina.

Another group of special needs persons are those under the control of local and State correctional facilities. With the approach of Hurricane Katrina, some facilities evacuated prisoners in the days prior to landfall. A few facilities, most in Orleans Parish, did not evacuate prior to the storm. The Louisiana Department of Corrections stated that the evacuation, although a “logistical challenge,” was safe and efficient (DPS, 2005).

Shelters

In Mississippi, over 50 shelters were opened and 36 more were placed on stand-by (United States, 2006a). These shelters were primarily schools and churches operated by the American Red Cross. Special needs shelters and a pet friendly shelter in the Jackson Coliseum were

also opened. By August 28, 2005 shelters were reported at full capacity. To support communities in the area, families at Maxwell Air Force Base took in pets from evacuees in Mississippi and cared for the pets throughout the incident and until the owners could be located (United States, 2006a). The Shelby County Humane Society in Alabama also sheltered pets during the emergency.

In Louisiana, shelters were established as part of the evacuation plan and were typically placed along the evacuation routes. A sheltering task force led by the Department of Social Services and the Department of Health and Hospitals coordinated activities with the State EOC and parishes (United States, 2006a). The American Red Cross began pre-landfall preparations on August 27, 2005 and had every resource at its disposal on alert or moving in anticipation of the event (United States, 2006a). As shelters in Louisiana began to reach capacity, shelters in Texas, Mississippi, and other nearby States began to open (United States, 2006a). Area churches in Louisiana implemented a program called "Brother's Keeper," which assisted in getting those who lacked transportation or had other special needs out of the area.

Throughout Louisiana, the American Red Cross opened 563 shelters which housed almost 150,000 people, but they did not certify any shelters in New Orleans (Brinkley, 2006). Ten special needs shelters were open in Alexandria, Baton Rouge, Bossier City, and Monroe and other municipalities and housed almost 2,500 people (United States, 2006a). In New Orleans, the Superdome, which had originally been designated as a special needs shelter, opened to the general population as a shelter of last resort. The pre-landfall population at the Superdome rose to approximately 12,000, which included approximately 400 special needs individuals (United States, 2006b). Shelters of last resort were also established in several other parishes (United States, 2006a).

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HURRICANE RITA – September 24, 2005

Number Evacuated: More than 3 million
Category: Natural
Specific: Hurricane

INTRODUCTION

Hurricane Rita made landfall near Port Arthur, Texas on September 24, 2005 as a Category 3 hurricane. Mandatory evacuations had been enacted in Florida and residents along the Gulf Coast began early-stage preparations for another mass evacuation. By September 21, 2005, Hurricane Rita had strengthened to a Category 5 hurricane and the projected path included the Houston area prompting an evacuation of Houston and the surrounding areas. With Hurricane Katrina fresh in their minds, Houston area residents began to evacuate in record numbers. The wide area affected and the strong encouragement of the local officials resulted in an evacuation of more than 3 million people (HRO, 2006) although most media reports place the evacuation estimate closer to 2 million people. As a result of the lengthy evacuation times in extreme heat, 130 fatalities were attributed to the evacuation (Henk, 2007).

Louisiana was also in the projected path, and residents in Cameron, Calcasieu, Jefferson-Davis, Acadia, Iberia, and Vermillion Parishes were encouraged to evacuate before the storm made landfall. In New Orleans, plans for reentry were postponed because of the weakened state of New Orleans levee system. The storm surge caused damage along the coastal areas of western Louisiana and southeastern Texas (Knabb, 2006). The storm surge and wind speeds in Galveston were not nearly as severe as feared. The levees breached in New Orleans, flooding the city again and delaying the return of residents.

History of Emergencies
The Gulf Coast States have historically experienced numerous natural and technological disasters including hurricanes, tropical storms, flooding, tornadoes, and chemical incidents. The region is often threatened with the possibility of hurricanes and 2005 had been a very active hurricane season. The Houston and Galveston area also has experience with hurricanes and tropical storms. The residents were sensitive to Hurricane Rita as a result of the catastrophic destruction that had occurred in Louisiana, Mississippi and Alabama only weeks earlier by Hurricane Katrina.

Emergency Preparedness
The Houston Emergency Management Plan provides the general and conceptual framework for a coordinated multi-agency response and efficient use of resources during a major emergency or disaster (Houston EMP, 2005). The Houston Emergency Management Plan includes elements such as chain of command, alerting, operating and recovery procedures, functions of the Emergency Operations Center (EOC), guidelines for coordinating operations between departments and the field, the authority for the development of training exercises, and responsibilities of each agency (Houston EMP, 2005). More recently, the Galveston-Houston area has adopted a zip code evacuation plan to facilitate staged evacuations in response to future hurricane threats.

According to Matagorda County Emergency Management, the location of the nuclear power plant within this coastal county has resulted in a very robust emergency management agency. The county emergency management personnel recognize it is better prepared to respond to emergencies due to the extensive training and daily coordination with response agencies.

Training

The Houston emergency plan requires training personnel to ensure that they are prepared to handle an emergency. Training includes awareness exercises, as well as more in-depth training for personnel who will be involved in either departmental or city emergency operations. Drills and exercises are conducted regularly at four levels including orientation, tabletop exercises, functional exercises, and full-scale exercises which simulate disaster events and include response and discussion in the field (Houston EMP, 2005).

Public Education

The Houston Office of Emergency Management provides educational opportunities to the citizens of Houston on home and business emergency preparedness, and response (Houston EMP, 2005). The community's awareness of hurricane hazards and the importance of evacuation was high, because of the recent events surrounding Hurricane Katrina. The Galveston County Office of Emergency Management web site includes information on evacuation.

In 2006, Galveston County proclaimed Hurricane Awareness Week in the County of Galveston. The intent was to remind residents at the beginning of the hurricane season of roles and responsibilities in response to the potential threat of a hurricane. To further improve public education for future responses, the Texas task force report recommended a 'targeted' public outreach effort that extends beyond public service announcements (Task Force, 2006).

EMERGENCY RESPONSE

Decision Making

Over 100 jurisdictional boundaries were crossed in the response to Hurricane Rita (Task Force, 2006). Local mayors or county Judges in Texas have the authority to order evacuations in their jurisdictions. Although authorizing local authorities this responsibility is typical, having no central authority to coordinate the timing of evacuations for a wide scale emergency can contribute to congestion (Task Force, 2006).

Two key decision issues for Hurricane Rita were the decision to order a broad based evacuation of the Houston area and the decision emphasize that residents not allow this to become "another Katrina." These decisions have been attributed to the overwhelming response of the public to the evacuation orders.

Communications with Emergency Responders

Emergency responders and local officials were aware of the approach of the storm days before landfall. Emergency responders were notified of conditions through the National Hurricane Center, national and local media coverage, and by senior officials. Emergency Operations Centers (EOC) and Incident Command Posts were used. Communications from the EOCs were coordinated through a JIC that collected and distributed information from departmental Joint

Information Officers (Houston EMP, 2005). Information was communicated between various agencies via internet, e-mail, fax, cell phone, telephone lines, satellite phones, and radios. Communication between emergency responders worked well in the planning, implementation, and post-event response.

Communication with the Public

Communities in Texas and Louisiana were notified and informed of the current emergency situation through a variety of means. These included television and radio broadcasts, National Hurricane Center updates, notifications and updates provided by local and State officials, Emergency Alert System (EAS) messages, cable TV overrides, internet updates, door-to-door notification, and dynamic message signs such as those displayed along highways (Houston EMP, 2005).

Although the messages were frequent and convincing and resulted in a very large compliance, according to the House Research Organization, the biggest failure of the Hurricane Rita evacuation was communication to the public (HRO, 2006). Officials advising the public to evacuate compared the incident to Hurricane Katrina and emphasized the deaths that occurred as a result of residents not evacuating for Hurricane Katrina. This aggressive form of communication resulted in two thirds of residents evacuating who in fact did not need to evacuate (TTR, 2006). Had the public been notified the evacuation would take more than 20 hours, residents could have better prepared by taking extra food, water, fuel, etc. Because people were unprepared, many residents gave up and turned around rather than risk being stuck in traffic when the storm hit (HRO, 2006).

The evacuation plan and notification system for the South Texas Project NPP was used in the Matagorda County response to Hurricane Rita. Radio, television and some route alerting was used to notify the area residents. All of these forms of communication are outlined in the emergency response plan for the South Texas Project NPP.

Evacuation

The evacuation of more than 3 million people in response to Hurricane Rita (HRO, 2006) was the largest experienced in Texas history. Not only did emergency responders have to deal with their own large urban population, but also an additional 400,000 evacuees that had been displaced from Louisiana by Hurricane Katrina and were residing in the Houston area (Task Force, 2006). In preparation for the hurricane, the Federal Department of Transportation (DOT) reached out to transit agencies along the Gulf Coast, and in cooperation with FEMA, staged 650 buses four days before landfall to support evacuation of Texas counties, New Orleans and southern Louisiana parishes (White House, 2005).

Evacuations were initially planned to be staged beginning September 21, 2005, with residents in more threatened areas of Texas, such as Galveston, Corpus Christi, and Jefferson County evacuating before residents in Houston. Some local officials organized people with large vehicles such as trailers to evacuate first, because these are more susceptible to accidents in high winds. The most obvious problem with the evacuation was the gridlock traffic leading away from the coast.

Having experienced traffic issues along the Texas coast in response to Hurricane Brett in 1999,

a contraflow plan had been formulated for I-37 in Corpus Christi (TTR, 2006). Plans to utilize contraflow on other interstates, such as I-10, were ruled out because of logistics and lack of manpower needed to implement such plans (HRO, 2006). By September 22, 2005, all major roadways out of Houston were at a gridlock. Contraflow was implemented late and was developed in an ad hoc manner. It took 10-12 hours to prepare for the start of contraflow on the three main roadways affected. To improve upon this in future responses, the Texas task force report recommends additional contraflow plans be developed (Task Force, 2006). These measures are now in place and ready to be used in the future, if needed.

With the large number of evacuees and lengthy travel times, necessities including food, water, restroom facilities, gas, and medical facilities were scarce along evacuation routes. In some areas, local officials prohibited cars from exiting the road, even for such emergencies as medical needs or picking up family members or children from daycare (HRO, 2006). The traffic conditions led to frustration and discomfort among evacuees. Thousands of evacuees turned around and returned to their homes, rather than endure the frustration or risk being trapped in their car when the hurricane arrived.

There was some difficulty in finding qualified bus drivers because once a mandatory evacuation was ordered, many drivers evacuated with their families (HRO, 2006). Some areas allowed bus drivers to take their families with them on their evacuation routes. This technique makes the order to assist in the evacuation of the public more appealing to the drivers (Task Force, 2006). Another concern was time the bus drivers would have to work. Bus drivers are often regulated on the amount of straight hours they are allowed to drive without rest. Placing more than one driver on each bus was considered as a possible solution; however, doubling up on drivers results in fewer buses available for the evacuation. Temporary emergency relief to this regulatory requirement was ultimately received.

In the Galveston area, pets were allowed on buses. In discussions with emergency management personnel involved with the evacuation, the placement of pets on buses was not a problem. These included dogs, cats, birds, snakes, and other household pets. Problems encountered were related to the long travel time causing some pets to overheat. Furthermore, there was a lack of food and water and no ability to deal with waste. As has been confirmed in past evacuations, people are often reluctant to leave their family pets at home, thus accommodating pets in Galveston was a proactive and successful initiative.

Special Needs

The emergency response plan for Houston identify special needs individuals as the responsibility of the institution. The plan did not address special needs individuals who do not reside in special needs facilities. There was also no comprehensive definition of special needs individuals, which was also an issue during Hurricane Katrina. The Hurricane Rita Evacuation Task Force report, defined people with special needs as “those who cannot take care of themselves during an evacuation” (Task Force, 2006). The definition includes the elderly, individuals with physical or mental disabilities and their care givers, the homeless, and those without transportation (Task Force, 2006). Although the definition of special needs individuals was not documented in the State of Texas or City of Houston emergency response plans, local officials in Houston, Galveston, and along the Texas coast recognized this population group and

implemented evacuation efforts. Considering the lack of preplanning for this population group, the evacuation of these individuals was organized quickly and generally conducted successfully.

Special facilities such as nursing homes and hospitals require extra attention during an evacuation, and under Texas law licensed facilities are required to have an evacuation plan. The law does not address the quality of the plan or its currency (Task Force, 2006). One of the greatest tragedies of Hurricane Rita occurred when a bus evacuating residents of a Bellaire, Texas nursing home caught fire and 23 of the passengers died. Many of the passengers were mobility impaired, making escape difficult or impossible. In other cases, arrangements made by nursing homes to shelter or transport their residents were compromised when State and Federal officials took beds or vehicles the nursing homes had planned to use (HRO, 2006). Additionally, several bus and private ambulance companies, which had been contracted by nursing homes, did not fulfill their duties to evacuate the residents either because they were over booked or because drivers had already evacuated (HRO, 2006).

A successful evacuation of a special needs facility included transfer of patients from the Texas Medical Branch Hospital to the University of Texas Health Care Center in Tyler, Texas. The evacuation of this facility had been discussed among emergency response personnel in planning activities; however, the facilities had never been fully evacuated. The ensuing evacuation was completed in a 12-hour period using ambulances, helicopters, planes, and buses.

Shelters

At least 150,000 people sought shelter in American Red Cross Shelters in response to Hurricane Rita. Shelters were established in Dallas, Austin, San Antonio, and many other communities throughout Texas. The shelter situation for Hurricane Rita was complicated because of the evacuees already in the area from Hurricane Katrina. Thousands of evacuees from Hurricane Katrina were in shelters in the Houston area, and these individuals needed to be re-evacuated for Hurricane Rita. In Austin alone, 50 shelters were opened to house 15,000 evacuees (ARC, 2005). Those evacuating were encouraged to stay with family or friends whenever possible. Schools, churches, stadiums, senior citizen facilities, and colleges were just some of the types of facilities that served as shelters for Hurricane Rita.

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HURRICANE WILMA – October 24, 2005

Number Evacuated: 300,000
Category: Natural Disaster
Specific Type: Hurricane

INTRODUCTION

Hurricane Wilma was the thirteenth hurricane of the 2005 Atlantic hurricane season and the third Category 5 hurricane of the season (NHC, 2006). After traveling through and causing considerable damage in the Yucatan Peninsula, Hurricane Wilma made landfall in southern Florida as a Category 3 storm on the morning of October 24, 2005. Evacuations in preparation for Hurricane Wilma began on October 19, 2005 when Florida officials ordered tourists out of southern Florida and closed schools to allow families to prepare and evacuate (Palm Beach Post, 2005). Estimates vary, but multiple media reports identify approximately 300,000 people evacuated in response to the hurricane.

The southernmost counties of Florida, including Monroe, Miami-Dade, Collier and Broward were the most at risk of hurricane force winds and flooding. This area attracts a large number of tourists and includes a large retirement community. Residents were strongly urged to evacuate the area in the days leading up to the storm. Reports indicate that as few as 10 to 20 percent of the population of the Florida Keys actually evacuated (Palm Beach Post, 2005), but other areas of Florida had a higher compliance rate.

Hurricane Wilma caused the largest electrical disruption ever reported in Florida leaving approximately 3,250,000 Florida homes without power. Turkey Point and St. Lucie nuclear power plants are both located in areas affected by declared hurricane warnings. St. Lucie County Emergency Management stated that traffic control points and evacuation routes used in the response to Hurricane Wilma were similar to those identified in the emergency response plan. Both plants declared Unusual Events as a result of the oncoming storm. St. Lucie and Turkey Point nuclear power plants received minimal damage from Hurricane Wilma (NRC, 2005a; NRC, 2005b).

History of Emergencies
Southern Florida is very experienced in hurricane preparedness and evacuation. As the thirteenth hurricane of the season, Florida had very recent experience with this type of emergency. Florida is also often threatened by other natural hazards, such as flooding, wildfires, and tornadoes.

Emergency Preparedness
The Florida Emergency Management Offices at the State and local levels have comprehensive emergency plans. The Monroe County Comprehensive Emergency Management Plan (CEMP) provides the framework for local officials to respond to any type of large scale emergency event. The plan details responsibilities of county, city, private and State agencies (Monroe County, 2007).

Training
Emergency response agencies in southern Florida regularly conduct emergency drills and exercises. In 2005, the emergency plans had been fully implemented in response to three other hurricanes that had threatened the area prior to Hurricane Wilma. The Miami-Dade County Office of Emergency Management and Homeland Security coordinates with Federal, State, regional, and local partners in training and exercises that strengthen the ability of the local emergency management community and prepare responders to manage large-scale incidents (Miami-Dade Emergency Management).

Public Education
Community awareness to hurricane hazards is high due to the frequency hurricanes threaten this part of the country. Brochures and informational packets are available to educate residents of their roles and responsibilities during a hurricane. Information is published in newspapers and presented through local media on where and how to access shelters.

EMERGENCY RESPONSE

Decision Making
Over 34 counties or jurisdictions responded to Hurricane Wilma. The State of Florida was highly involved in the response along with Federal agencies. Decisions to evacuate the threatened population were made by county managers, mayors, and local authorities. In Florida, this decision process is tested frequently, and confidence among the decision makers is high. The level of cooperation between local, State and Federal resources was good. As a result of pre-planning and responses to hurricanes earlier in the season, roles and responsibilities were well conveyed among different agencies and divisions. Many of these agencies work often together in planning, training and drills.

Communications with Emergency Responders
Local officials and emergency responders were aware of the approaching storm from media coverage, correspondence with the National Hurricane Center, and coordination with other agencies. Responders used radios, telephones, cell phones, and satellite phones to communicate with each other (Florida Emergency Management, 2005a). In Indian River County, the communication tower for the EOC was destroyed and the facility severely damaged, requiring the EOC to be moved to the sheriff's office. Despite power failures and some localized communication issues, the State EOC was able to conduct scheduled conference calls with the counties (Florida Emergency Management, 2005b).

Communication with the Public
While Hurricane Wilma was in the Gulf of Mexico, it was reported as the largest and most intense hurricane ever recorded resulting in extensive national and local media coverage many days in advance of landfall. The hurricane moved very slowly and provided southern Florida time to prepare and notify the public. Evacuation notices as well as shelter locations were announced through local media, and information was available on emergency management websites. In some areas, police and emergency responders drove through neighborhoods with bullhorns, or went door-to-door urging residents in threatened areas to evacuate. Communication during the evacuation included local television and radio broadcasts and

dynamic message signs along the highways. Florida also has a 311 telephone system available for people to call for information throughout an incident.

Evacuation

Evacuation efforts began on October 19, 2005 when tourists were encouraged to leave the area. Residents began evacuating on October 21, 2005 when many counties across southern Florida ordered mandatory evacuations for those residing in low lying areas, mobile homes or substandard homes (Florida Emergency Management, 2005d). Voluntary evacuations were in effect for populations outside of these areas.

Due to a low compliance rate, reported as less than 20 percent, the traffic density during this time frame was similar to that which occurs on a daily basis in Southern Florida (Keynews.com, 2005). Because Hurricane Wilma traveled very slowly across the Gulf of Mexico, people were able to watch it slowly dissipate from a Category 5 storm down to a Category 3 storm. Emergency management officials also attributed this low rate of compliance to the fact that many people had evacuated needlessly for other hurricanes. Some people did not have the funds to evacuate, because they had exhausted their funds in previous evacuations. Another reason attributed to low compliance is the understanding that there are more stringent building codes in Florida, and some people believe their homes will withstand strong winds (USACE, 1999). Some residents were not convinced they were in the hazard area.

During the evacuation some highways were reported as severely congested, but this was mostly attributed to areas where minor accidents had occurred.

Special Needs

At least four hospitals were evacuated in response to Hurricane Wilma including the Glades General Hospital and Hendry Regional Hospital (Florida Emergency Management, 2005c). There were also more than 20 Adult Family Care Facilities and Assisted Living Facilities and approximately 60 nursing homes evacuated (Florida Emergency Management, 2005c).

The Emergency Evacuation Assistance Program is one of many programs that encourage those who require skilled nursing care, assistance with daily living or are on life saving medical equipment dependent of electricity to register with their local Office of Emergency Management. Registration includes identifying the means of assistance needed in the case of an emergency. Florida emergency management agencies acknowledge the special needs population that does not reside in special facilities and implement programs to identify this population before an incident occurs. Although their programs are mature, the percentage of individuals registering for support in Florida is still relatively low. The reasons for this may include an assumption by special needs individuals that someone (friend or family) will be willing to assist them; some individuals have reported being sensitive to their disability and their need for assistance; some individuals are concerned about the security of their personal data; and others simply do not realize they are in the special needs population. The latter is particularly true of elderly individuals, who may believe they are able to evacuate, but should not be attempting a multi-hour evacuation.

Shelters
Miami-Dade County, Monroe County and others have plans in place to transport people via bus to shelters during a hurricane evacuation. Residents are told to listen to the media or call 311 for bus information. There is one highway in and out of Monroe County, and residents requiring a ride wait on the side of the road for bus transportation.

Residents in Florida are encouraged to try and shelter first at a friend or family residence outside the evacuation zone in lieu of sheltering at a Red Cross facility. Over 120 shelter facilities were open accommodating almost 40,000 evacuees. At least 27 special needs shelters were available and these facilities accommodated over 2,150 special needs individuals (Florida Emergency Management, 2005c). Florida also has an effective pet friendly shelter program, but these shelters can reach capacity quickly. Typically, counties in Florida request that residents apply for admittance or make reservations for a pet-friendly shelter.

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Florida Emergency Management, Monroe County

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NEW ENGLAND FLOOD, 2006

Number Evacuated: Approximately 7,000
Category: Natural Disaster
Specific: Flood

INTRODUCTION

From May 11 to May 23, 2006, record amounts of rainfall fell over Massachusetts, New Hampshire, and parts of southern Maine. Flooding that occurred as a result of the heavy rainfall was reported as the worst since the New England Hurricane of 1938 (CBS, 2006). More than 7,000 people were evacuated under mandatory and voluntary evacuation orders as flood levels rose. Homes were evacuated on an as needed basis depending on where they were located in the flood plain and according to projected forecasts. Frequently, homes in lower lying areas of communities were the only ones evacuated. Dams within the region were at capacity with some breaches further contributing to the flooding (Portsmouth, 2006a).

The Seabrook and Pilgrim Nuclear Power Plants are located in the region affected by the May 2006 floods. Pilgrim is located near Plymouth, Massachusetts, and Seabrook Station is located in Seabrook, New Hampshire, approximately 65 km (40 miles) north of Boston, Massachusetts. There were no reports of flooding at either facility.

During the recovery effort, there was a report in Lawrence, Massachusetts of the need for bilingual staff to support the completing of paperwork for assistance. City employees assisted in translating where needed, and the Red Cross provided a few Spanish speaking rescue workers (Boston Globe, 2006). There were no reports identified of issues with the evacuation due to language barriers.

History of Emergencies

The Massachusetts and New Hampshire area is experienced with flooding and hurricanes, and almost every year some evacuations are required in response to flooding. All five of the Federally declared major disasters in the Massachusetts since October 1996 involved flooding.

Evacuations in response to flooding had also occurred in October of 2005 in many of the same areas. During the October 2005 flood, several fatalities were reported of individuals who did not evacuate. Local authorities attribute some of the cooperative response of the public during the 2006 floods to the realization of the consequences of not following the direction of emergency responders.

Emergency Preparedness

Emergency preparedness activities are conducted extensively at State and local levels. These activities include preparing plans, conducting training exercises and drills, and educating the public of local emergency hazards. Planning is conducted by both State and local emergency management agencies. The New Hampshire Radiation and Emergency Plans Coordinator stated that emergency responders located within the Seabrook Emergency Planning Zone are

well prepared to respond to various types of emergencies due to frequent training and exercises conducted for the plant.

The communities are aware of the alerting mechanisms used for this type of disaster. The public is often informed of hazardous situations through EAS messages announced over local radio and television stations, through local law enforcement, and Reverse 911® systems.

Training

Training is provided for emergency responders and includes, but is not limited to, training on the Incident Command System (ICS), National Incident Management System (NIMS) awareness training, hazardous material awareness, mass care and logistics. The community emergency response agencies regularly conduct drills and exercises ranging from table-top exercises to full-scale drills. These types of drills are conducted locally, regionally, and State wide. Emergency plans used in the May 2006 Floods were previously tested in a full-scale field exercises.

Public Education

Proactive measures are in place to improve and maintain community awareness of local hazards. One program in Massachusetts involves emergency management officials going to local public events to educate the public. New Hampshire has an informative website where citizens may obtain information and answers to common questions related to local hazards.

EMERGENCY RESPONSE

Decision Making

Affected counties within New Hampshire and Massachusetts used their emergency plans in response to the flooding. Local officials ordered evacuations, and there were no major problems reported with the decision making process or with the time spent on decision making. The level of cooperation among local and State agencies was reported as good during the incident. Only minimal Federal assistance was needed for this emergency response, because efforts could be adequately controlled by local and State resources. Local and State emergency management agencies, along with police and fire departments, aided in the evacuation effort. The command and control process during the response was carried out according to existing plans.

Communications with Emergency Responders

Regional and local EOCs were used for the emergency response. Using local EOCs provided the regional EOC a better perspective of the overall response. There were no problems relaying information between field emergency responders and the EOCs. Cell phones, radios, and a web based EOC were all forms of communication between responders. Responders followed ICS and Emergency Support Function (ESF) guidelines to assign and communicate responsibilities and roles. This structured system assigns agencies with similar functions to work together to accomplish a common goal. There were no reports of confusion on responsibilities.

Communication with the Public

As conditions gradually worsened in the days prior to evacuations, officials and the public were notified of the conditions via extensive television and radio coverage. There were no problems with the notification. The means by which the public was notified of weather conditions and evacuation status was dependent upon the location of the community. Methods of notification included EAS messages on local TV and radio stations, route alerting with public address systems, Reverse 911® calls, and door-to-door communication. Due to the nature of the flooding, evacuations did not occur simultaneously.

Communication issues were reported in post-incident recovery efforts. In Lawrence, Massachusetts a large percentage of the population spoke only Spanish (Boston Globe, 2006). Translators were needed to communicate directions in completing forms in the recovery effort.

Evacuation

Due to the localized areas of flooding, evacuations were typically conducted on a small scale, although there were some instances of entire communities needing to evacuate. Evacuees were informed of shelters in the area, but were not provided specific directions to their location. In these small communities, residents generally knew the locations of the schools and community centers and directions were not needed. Often, families were simply instructed to move to higher ground and were able to return to their homes within a few hours. There were cases of families evacuating before they were ordered to do so, but this was not a problem.

More than 600 roads were closed in New Hampshire (Portsmouth, 2006b) at various times due to flooding. The Army National Guard assisted in manning road blocks, and the Department of Transportation was involved in repairing roads damaged by the flooding. Residents were cooperative and usually left early enough to avoid problems in reaching their desired destinations. Some of the evacuated areas included residents dependent upon public transportation. No plan was in place to evacuate these individuals, and they were able to evacuate either with the aid of family and friends or by using the regular public transportation system.

Police aided in directing traffic and manning road blocks. State officials said that the evacuations as a whole went very well, and no major problems were identified.

Special Needs

Several special needs facilities were evacuated as a result of the flooding, including several nursing homes and a half-way house with 40 female inmates (AP, 2006). It took approximately 10 hours to evacuate one nursing home, when a hoist was required to be constructed in order to safely move a non-ambulatory patient from a sub-level floor. In Lawrence, Massachusetts, a large nursing home with approximately 243 residents was evacuated in 8 hours. Due to the fast rising flood, evacuees had to be floated out of the facility in oversized laundry bins (Catholic Health World, 2006).

In New Hampshire several special needs individuals were evacuated to shelters (Portsmouth, 2006a). The States of Massachusetts and New Hampshire both recognize the concern of evacuating special needs residents, and both agree that there is definite room for improvement on how this evacuation could effectively be completed. Although it is encouraged at the State

level for special needs plans to be created, it is ultimately up to local jurisdictions to create such plans and registries to identify this population. Also, because of privacy issues, which are also cited as primary reasons for not registering in other States (HRO, 2006), it is often left up to the individual to register themselves as a special needs person.

Shelters

Shelters were open throughout the region and were run primarily by local chapters of the American Red Cross. At least 14 shelters were open in Massachusetts, and at least 18 shelters were opened New Hampshire (ARC, 2006) with community centers, gymnasiums and schools used as shelter locations. Local restaurants donated a large amount of food and water to the shelters, and there were no reported shortages of necessities. It was estimated that approximately 10 percent of those who were evacuated went to a shelter.

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New Hampshire Emergency Management Department

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CHEMICAL FIRE, Apex, North Carolina - October 5, 2006

Number Evacuated: Approximately 17,000
Category: Technological Disaster
Specific Type: Hazardous Materials Facility Fire

INTRODUCTION

On the evening of October 5, 2006, a fire started at a hazardous waste management and transportation facility in Apex, North Carolina. Responders who arrived at the site described a haze in the air near the storage facility and observed smoke coming from the building. The Apex Fire Chief immediately ordered the team to back off and directed that water not to be used on the fire. The Fire Chief contacted Wake County Emergency Management and requested notification calls to residential and business telephones within 0.8 km (0.5 miles) of the facility. A message instructed the public to "stay inside, close windows and doors and listen to the radio or television for further information." At 10:00 p.m., an evacuation order for the same area was issued. The evacuation order was expanded to a 1.6 km (1 mile) radius from the facility about 90 minutes later. The Apex response included implementation of shelter in place, a large scale evacuation, evacuation of a nursing home, and evacuation of transit dependent individuals. Each of the response elements was successfully implemented and the protective action response activities were complete within about 6 hours.

Some law enforcement personnel reported being overcome by fumes as they conducted house to house evacuation notifications. This resulted in the evacuation zone being expanded to 6 km (3.75 miles) downwind of the facility. Evacuations continued through the night with the final evacuation zone established around 4:00 a.m. on October 6, 2006. Approximately 17,000 residents were estimated to have evacuated (National Response Center, 2006), and a shadow evacuation of more than 30,000 people was also reported.

Eighteen people were taken to emergency rooms complaining of respiratory problems, including 12 police officers and three firemen. Area hospitals registered 45 people complaining of respiratory distress; however, no one was admitted as a result of health issues caused by the fire.

History of Emergencies

Community evacuations had not occurred in Apex in the previous ten years, although evacuations in localized areas have occurred as a result of hurricanes, winter storms, and severe thunderstorms. Approximately one year earlier, various agencies and jurisdictions had worked together to assist in the recovery efforts following Hurricane Katrina. The Town of Apex was actively involved in sheltering Hurricane Katrina evacuees, as well as getting separated family members back in touch with one another. Through these activities as well as others, emergency responders were proficient with communicating with one another and well aware of responsibilities in an emergency situation.

Emergency Preparedness

Emergency management departments from the town of Apex and Wake County have been working together for years. The chemical facility and the declared evacuation zone are within the 16 km (10 mile) emergency planning zone (EPZ) of the Shearon Harris nuclear power plant (NPP) where emergency response planning is extensive. Apex did have an emergency plan in place prior to the chemical fire. The plan had recently been updated to comply with the requirements mandated for the National Incident Management System (NIMS) and had been coordinated with the emergency response plan for Wake County. The emergency plan had been coordinated between the Shearon Harris NPP and State and local emergency response agencies and provided a strong foundation for the response actions during this incident.

Training

Town personnel had recently been trained on the use of the town emergency plan. Emergency responders were also required to attend the State Fire Marshall's Unified Command and control training (NF&R, 2007). In Apex, fire and law enforcement personnel are provided annual refresher training for the Shearon Harris NPP Emergency Plan response. Local, county, and State emergency responders are continuously involved in joint training exercises, drills, or response activities for a variety of reasons, including their responsibilities for the Shearon Harris NPP. Drills range from table-top exercises to full-scale field exercises. Apex fire and law enforcement departments, town employees, department heads, and town council members were required in 2005 to complete NIMS training (NF&R, 2007). In addition to training required within agencies, several industries in Wake County conduct training drills for emergency responders. There had not been any such drills or training conducted with the chemical facility.

Public Education

Public awareness is considered high for the Shearon Harris NPP, but few people knew of the chemical facility or the types of materials it handled. Residents within the 10 mile EPZ of the Shearon Harris NPP are provided annual information describing emergency response activities in the event of an incident at the plant. Annual Safety Awareness Days are conducted by the Apex Fire Department addressing a variety of safety topics including evacuation.

EMERGENCY RESPONSE

Decision Making

The Apex Fire Chief was the Incident Commander and made the decision to evacuate. The decision making process was clear, and decisions were made and executed in a timely manner. The level of cooperation among local, State, and Federal agencies prior to, during, and after the incident was considered outstanding. The Town of Apex fire, Emergency Medical Service and law enforcement agencies have had "mutual aid" agreements in place with the surrounding communities on a continuing basis. The success of the incident response was attributed to the cooperation between local, county and State personnel. Federal responders brought expertise and also cooperated well with local responders.

Communications with Emergency Responders

The initial dispatch of first responders was through the Wake County computer-aided dispatch (CAD) system via radio and pager. The Raleigh Hazardous Materials Team was also notified through the CAD system. There were no problems in notifying emergency personnel.

An EOC was activated by Wake County, and a field incident command post (ICP) was established after the Incident Commander arrived on-scene. The ICP was relocated four times during the incident due to changes in wind direction. Communication among responders included cell phones, NEXTEL Direct Connect, 800MHz radios, Sprint Air Card for Internet access, and access to the Wake County local area network system. The majority of communication between field responders and the ICP was conducted via the Wake County 800 MHZ system (NF&R, 2007). At the time, law enforcement personnel were not on the 800 MHZ system. To address this communication gap, a law enforcement employee was stationed at the command post to convey messages to field police personnel (NF&R, 2007). All communications systems worked well throughout the incident.

Roles and responsibilities were communicated and assigned according to the Incident Command System (ICS). With several different agencies reporting to the scene, the ICS allowed for easy communication between agencies. Agencies were organized according to their discipline.

Communication with the Public

The "Communicator System," similar to a Reverse 911® system, was used to notify residents of the evacuation. The public was also notified through EAS messages, NOAA Weather Radio, Radio and TV broadcasts, and in some cases, door-to-door notification from law enforcement personnel.

Hospitals around Apex were notified of the incident and made aware that an increase in patients may be expected as a result of side effects from the chemical fire. A decontamination station was set up outside hospitals for any patients that might be contaminated (NF&R, 2007). The Wake County School System was also notified that three schools were being used as shelters. Following the evacuation, information was provided to the public via a media center. Residents could call or visit and obtain information on the status of activities.

Evacuation

The evacuation began at around 10:00 p.m. on October 5, 2006, and within about six hours 17,000 residents, or approximately 50 percent of Apex, North Carolina, was evacuated. Emergency responders estimated that more than 30,000 additional residents left during a shadow evacuation. The evacuation was staged with very clear geographical demarcation areas conveyed to the public. The success of the evacuation was attributed to the professionalism of the fire department and law enforcement personnel.

Initial protective action instructions to shelter in place were provided by emergency responders through the media. It was observed that most people were willing to comply with those instructions. When an evacuation was ordered for an area, people generally complied with the request. Some people evacuated spontaneously before being told to do so, and a small number of people chose not to evacuate.

An early issue in the response was whether enough emergency responders were available to assist in road closures, evacuations, and directing traffic out of the area. However, extra personnel were obtained after the North Carolina State University football game ended and State troopers, county sheriffs, and police became available to help with traffic (NF&R, 2007).

Traffic control points were manned until the evacuation order was lifted. No traffic problems were encountered during the evacuation, and only a few minor accidents were reported.

Residents were provided specific instructions of where to go if they were evacuated. The Apex Town Manager informed the public via television broadcasts that if evacuees needed a place to go, they could shelter at the Olive Chapel Road Elementary School or the Timber Creek Elementary School. Raleigh city buses were mobilized ad hoc to transport any persons who required public transportation out of the area. Few people used the bus transportation.

A significant part of the town's physical resources was cut off as the plume spread quickly. Fire stations, the Apex Police Department, town hall, and the community center were in the plume pathway (NF&R, 2007). The Apex Police Department and 911 Center were also evacuated. There were approximately 15 police cars in the parking lot that could not be used since they were considered contaminated. Thus, some police officers that were called to duty, had no vehicles.

Apex law enforcement went door-to-door following the evacuation order to verify that residents within the evacuation zone were aware of the situation and had evacuated if they chose to do so. Any resident that needed to reenter the area had to report to a specified location and request an escort. These situations were limited to an emergency only basis and typically took a few minutes to complete.

Special Needs

The Shearon Harris NPP does provide a means for residents within the 16 km (10 mile) EPZ to register if assistance is needed in the case of a NPP incident, but the plan does not extend to other hazards that could require evacuations. There were no reported incidents of residents not being able to evacuate. The city medical branch assisted in the evacuation of 103 nursing home patients from a single nursing home. Seventeen ambulances, wheelchair vans, and two transit buses were used to evacuate the facility (NF&R, 2007). The evacuation of the nursing home was completed without incident in about 3.5 hours.

Shelters

As identified in the emergency plan, the Community Center, which is also the town shelter, was in the process of being to opened as an evacuation center. During the time frame in which the center was being prepared, the plume changed direction placing the center within the evacuation zone. The center was then required to evacuate.

The American Red Cross managed two reception centers, and Wake County Human Services managed one shelter. Another shelter was opened at Green Hope High School, north of the town. The two reception centers were later consolidated at a high school. Approximately 500 persons reported to shelters, and approximately 10 support personnel were located at each shelter to assist evacuees. Local restaurants donated a large amount of food and water to the shelters, and there were no reported shortages of necessities.

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Town of Apex Fire Department
Apex Police Department

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HAWAII EARTHQUAKE - October 15, 2006

Number Evacuated: Approximately 3,000
Category: Natural Disaster
Specific Type: Earthquake

INCIDENT DESCRIPTION

On October 15, 2006, two earthquakes occurred within a few minutes of each other in Hawaii in the general vicinity of the towns of Hawi and Kiholo Bay. Hawi is a small town on the island of Hawaii. Tremors resulting from the earthquakes were felt throughout all of the islands. The Hawi earthquake was considered a separate earthquake because of its distinct source location (Brandes, 2006). Extensive, mostly non-structural damage occurred as well as landslides, power outages and waterline breaks which were reported to some degree throughout West Hawaii. Around seventy percent of the island was without power for varying periods of time.

Approximately 3,000 people were evacuated from Kona and South Kona, many of which were from hotels that were damaged (Harris, 2006). Kona Community Hospital was also evacuated because of damage. Most of the evacuees stayed on the island and moved to temporary shelters. Evacuees from the Kona Community Hospital were taken to the Keauhou Sheraton Conference Center (Chock, 2006), and a few acute care patients were flown to Hilo Medical Center. About 50 residents were moved from a long-term care facility in Honokaa, and 60 residents were evacuated from the Paniolo Club condominiums.

It was determined there was no threat of a tsunami, but police implemented tsunami plans to keep traffic moving on the roadways. Residents and tourists who did not have to drive were encouraged to stay off the roadways, and police reported people were cooperative with emergency response. The disaster occurred early on a Sunday morning when people were just getting up and traffic on the roadways was light.

History of Emergencies
The State and island of Hawaii are susceptible to evacuations due to natural hazards including volcanic eruptions, hurricanes, earthquakes, tsunamis, fires, and floods. Previous evacuations have occurred for the 2006 floods in Huula, the 2005 wildfire in Waikoloa, and the 1989 Kalapana earthquake Hawaii experiences thousands of minor earthquakes each year, most commonly attributed to lava moving below the surface. Most of these earthquakes can only be detected through the use of seismic instruments, and those that can be felt seldom result in damage to infrastructure.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, and community awareness. Prior to the 2006 earthquake, Hawaii revised their emergency plan to include the 2006 National Incident Management System (NIMS) recommendations. At the time of the earthquake, the revised plan had not been implemented; however, emergency responders were able to carry out an efficient response effort by using the current version of the emergency

response plan. Of note in this incident was that most of the evacuations occurred in hotels and at a local hospital. These facilities are required to have local emergency response plans.

Training

Training among industry and emergency response agencies is conducted annually on such subjects as Federal Emergency Management Agency (FEMA) processes, Homeland Security, NIMS, multi-agency training, and hazardous materials. The Hawaii Civil Defense department conducts regular training exercises (Hawaii County Mitigation Plan, 2007). Hawaii county and the State of Hawaii regularly conduct drills and exercises ranging from table-top exercises to near full-scale drills.

Public Education

The community is aware of the local hazards and evacuation procedures. However, the majority of those evacuated following the earthquake were tourists and hospital patients. As a result, it is expected that the awareness with evacuation procedures for those who were actually evacuated was low. The community was also aware of how to obtain information concerning necessary actions in the event of an earthquake. Most residents relied on television or radio sources to obtain information concerning the earthquake even though a power outage made information difficult to obtain in the first few hours.

EMERGENCY RESPONSE

Decision Making

According to the Administrator for Hawaii County Civil Defense, there was a strong sense of cooperation between local, State and Federal organizations from the beginning. “Everyone on the island knows everybody and there’s a cooperation that you don’t see on the mainland, and it makes things easier” (Harris, 2006). FEMA has a Pacific Area office located in Honolulu and representatives were at the State emergency operations center within hours of the earthquake.

Communications with Emergency Responders

State and local officials were well aware of the occurrence of the earthquake which were felt throughout the Hawaiian islands. Emergency responders knew from plans in place that they were to report to the Civil Defense Office. An EOC was set up at both the State and local levels. The State EOC was located in Honolulu and the Hawaii County EOC was located in Hilo (Hawaii County Mitigation Plan, 2007).

This full-scale disaster required warning, evacuation, police, fire, ambulance services, mass care, damage assessment, and medical services to support the response. Emergency responders were dispersed throughout the affected area and were able to communicate with State and county EOCs. Radios, cell phones and telephones were the primary form of communication between emergency responders.

Communication problems did occur when the power went out at the beginning of the incident. The high volume of calls made in the minutes and hours following the earthquake jammed telephone lines making communication among emergency responders difficult. As a result, residents were encouraged not to use the telephone unless it was an emergency. The Civil

Defense broadcast EAS reports to inform the public of the hazard status and that a tsunami was not a threat. Because of the power outages, few people received the early EAS messages.

Communication with the Public

Guests staying in hotels were notified to evacuate via the facility public address systems and staff going door-to-door. No problems with communication were reported and guests cooperated with directions. The community had previous experience with the alerting mechanism used including EAS messages broadcast by radio and television stations. The island does have emergency sirens, but these are used only in the case of an approaching tsunami. Since a tsunami threat was not a concern with this emergency, the sirens were not used.

Some members of the public felt that they were not properly informed of necessary actions following the earthquake. This lack of communication caused frustration among residents, especially those located in a tsunami evacuation zone. The residents did not know if the earthquake had been strong enough to warrant an evacuation of the coastal area. Some residents felt that the emergency sirens should have been used following the earthquake. However, Civil Defense stated that the sirens were not used in this emergency because there was no threat of a tsunami. It was imperative to the Civil Defense department that the public not lose trust in the meaning of an alarm when there was no imminent danger at hand. For some time following the earthquake, the only way to inform the public on the western half of the island was through emergency responders making rounds notifying residents that there was no tsunami threat present.

Evacuation

The evacuation of the hotels and hospital was conducted relatively quickly. The number evacuated from each facility was small, and the distance needed to move people to safety was not far. Hapuna Beach Prince Hotel staff stated that it only took a few minutes to evacuate the hotel. Police did man traffic control points after the earthquake, and evacuees were given specific instructions about where they were supposed to go. Traffic lights were non-functional due to the loss of power.

Road transportation was disrupted in some places due to landslides and damage to bridges. There are limited roadways within Hawaii, and when roads are closed, areas can be essentially cut off from access by emergency response vehicles. The area of North Kohala, including Hawi, was cut off from the rest of the island for hours due to road closures. Kawaihea Port handles approximately 60 percent of the imports coming to Hawaii and was also closed following the earthquake.

Special Needs

This evacuation was unique because primarily special facilities were evacuated. The decision to evacuate was made by officials at these locations. The manager of Mauna Kea Beach Resort and Hapuna Beach Prince Resort decided to evacuate guests immediately after the earthquake in order to assure that the buildings were safe (Pacific Business News, 2007). Hospital facility administrators decided to evacuate patients from Kona Community Hospital and the long-term care facility in Honokaa. Kona Hospital patients were assisted and cared for by hospital staff until they could be transferred to other facilities. The power went out at the

hospital and none of the elevators were on backup generators. The evacuation required patients be taken down stairways (Chock, 2006). Some patients were housed for a few days in a hotel with their caretakers until the hospital could be repaired (RMS, 2006). There were no reports of injuries to patients caused by the evacuation efforts.

Shelters

Following the earthquake, shelters were opened and operated by the American Red Cross. Patients from Kona Hospital were evacuated to a shelter at the Keauhou Sheraton, which was staffed by nurses and volunteers. Other Red Cross shelters were opened at Yano Hall, the Old Kona Airport, and the Waimea Community Center (ARC, 2006).

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CALIFORNIA FIRES, 2007

Number Evacuated: > 900,000
Category: Natural Disaster
Specific Type: Fire

INTRODUCTION

Between October 20th and November 9th 2007 a series of 23 wildfires burned across areas of southern California from Los Angeles and San Bernardino Counties in the north down to San Diego and Imperial Counties near the US-Mexico border in the south. During these 19 days, the fires burned some 517,267 acres and consumed 3,204 structures, including 2,233 homes, 5 businesses, 966 out buildings (OES, 2007a). In addition to the destruction of property, the flames also tragically resulted in the deaths 12 people identified at the time of this research, and were attributed to the injury of an additional 139 people (OES, 2007a), including more than 60 firefighters. The wildfires also precipitated the largest evacuation in California's history, with some estimates suggesting the emergency relocation of nearly a million people (LA Times, 2007).

One of the most commonly cited contributing factors to the fire danger in the fall of 2007 were the drought conditions which have existed periodically in the region for the past decade. This, combined with seasonally hot weather and strong Santa Ana winds, created favorable conditions for the creation and rapid spread of wildfires. Wind gusts during the fire period were reported by the San Diego City Fire Department officials to have reached and even exceeded 100 mph in some locations. Multiple sources have also been suggested as causes for the fires in the different locations around the region.

As California is a Mutual-Aid State, the effort to fight the fires, coordinate the evacuations, and accommodate the needs of the displaced and injured residents was shared among agencies at all jurisdictional levels, including city, county, State and the Federal governments. Fire fighters and emergency management and response agencies also benefitted from the lessons learned from previous fires, most recently a similar series of wildfires in 2003. Interviews with local officials clearly asserted that all of these factors combined to undoubtedly save both people and property from even greater losses. However, the interviews also showed that despite these successes, the knowledge gained from recent experience, and the benefits achieved from the shared effort, the enormous size and fast-moving nature of the 2007 fires combined with the enormous populations in the area did result in some problems of communication, coordination, and public response. An official After Action Report (AAR) conducted by the City of San Diego documented both the lessons learned from the event as well as recommendations to address them in the future (AAR, 2007).

History of Emergencies

Because of its size, diverse geography, active geology, large population, and significant industries, the State of California is confronted with a wide spectrum of natural and man-made hazard threats, including earthquakes, floods, landslides, wildfires, and radiological/nuclear among many others. FEMA records show that, historically, California ranks second only to Texas on the number federally declared disasters. Since 1953, the state has seen 73 disaster

declarations (compared to 81 in Texas) for an average of nearly one and a half disasters per year. This figure is also more than twice that of the national state average (FEMA, 2008). In addition to these federal declarations, state records indicate that another 64 Emergency & Disaster Proclamations and Executive Orders have been issued by the state government since December of 2003 (CA-OES, 2008).

Wildfires constitute a significant percentage of California's large scale emergencies. The case study of the 2003 wildfires showed that the state's Department of Forestry and Fire Protection responds to more than 5,000 fires annually with about 97 percent of these extinguished the first day (CDF, 2003). With this volume of activity, the State of California and the Forest Service have actively progressed in emergency planning and response to fires, most notably in the Standardized Emergency Management System. The SEMS requires the State of California to use a standardized emergency management system from which the Incident Command System (ICS) is based on.

Emergency Preparedness

To confront the array of hazards that threaten the State, California officials have a robust and complex management structure for coordinating responses to emergencies. In past fires, the California Fire Plan, National Fire Plan, ICS, SEMS, Multi-Agency Coordinating System (MACS), and other programs have all been employed. These programs are intended to unify various fire agencies to provide consistent direction and information to responders, policy makers, and the public. Another of the cornerstones of this unified response approach is the State's Mutual Aid Plan (OES, 2007b). Its primary purposes include the following goals:

- To provide for systematic mobilization, organization and operation of necessary fire and rescue resources of the state and its political subdivisions in mitigating the effects of disasters, whether natural or man-caused.
- To provide comprehensive and compatible plans for the expedient mobilization and response of available fire and rescue resources on a local, area, regional and statewide basis.
- To establish guidelines for recruiting and training auxiliary personnel to augment regularly organized fire and rescue personnel during disaster operations.
- To provide an annually-updated fire and rescue inventory of all personnel, apparatus and equipment in California.
- To provide a plan and communication facilities for the interchange and dissemination of fire and rescue-related data, directives, and information between fire and rescue officials of local, state, and federal agencies.
- To promote annual training and/or exercises between plan participants.

The basic concept of the structure is to have situations dealt with on a local level. Then, as local agencies find their resources inadequate to confront the threat; they are able to request assistance from other local and regional jurisdictions. Ultimately, requests for assistance can go up to the state and even federal level as conditions warrant. One example of assistance going all the way up to the State and Federal level was in the contribution of 1,500 California National Guard troops an additional pledged of up to 17,000 other military personnel if needed. Military aircraft and Fire engines were also made available for use during the firefighting efforts and 100 California National Guard medical personnel provided medical assistance.

Interviews with local officials also pointed out some of the difficulties that can also occur within the Mutual Aid system. When response personnel are called to emergencies outside of their home jurisdiction, they may leave their home areas more vulnerable to other hazards. As an example, the City of San Diego only had 40 fire fighters and 10 fire engines to cover their entire city during the wildfire emergency. An apartment fire that occurred within the city while the wildland fires were underway resulted in a loss of seven apartment buildings to a fire that would have normally been extinguished before reaching this level had a full contingent of resources been available. San Bernardino County officials also pointed out that since response workers are often waiting to be called to an out of jurisdiction emergency, it caused additional stress on personnel and resources as they wait to be called.

Since the 2003 fires the governor has increased funding to state fire protection by 84 percent. Since 2003, 109 fire engines have also been purchased, there is year-round staffing in high-risk areas, the Reverse 911® system and similar systems have been expanded and there has been coordination between the Multi-Agency Incident Resource Processing System with the California Fire and Rescue Mutual Aid System.

Training

Training for fire fighters is complex and diverse and includes many different agencies (Campbell, 2004). Routine training includes drills and exercises that focus on fire safety and response. The regional law enforcement academy is located in San Diego providing a common training foundation for many of the agencies that ultimately respond to cross jurisdictional emergencies such as the fires. Cross jurisdictional exercises are conducted throughout the region including the State's Golden Guardian exercise series initiated in 2004. Since the 2003, more than 377 firefighters have been trained in wildland urban interface firefighting techniques (CDF, 2005). The Forest Service has also increased the numbers and readiness of firefighting resources. The Forest Service has also implemented a leadership training course with the intent of increasing the abilities of leaders to make appropriate decisions and take independent action when necessary (CDF, 2005).

The State of California also maintains an exercise resource web page whose purpose is to enable practitioners to easily access to standardized and well-established exercise resource materials that can be adapted for local agency use. The materials included on the site represent a cross-section of exercise types from natural hazard to terrorism events. The state OES also maintains a training branch to offer exercise design courses (OES, 2008a).

Public Education

The communities of Southern California are generally aware of the fire risk; however, a finding of the Blue Ribbon Report (Campbell, 2004) was that a comprehensive public awareness education program is needed. Through community awareness groups such as MAST in San Bernardino, efforts are being implemented to better educate the public of their environment and responsibilities. Forestry and fire departments are now taking a proactive approach to educate the public on fire safety through interactive websites, videos, fact sheets and community group presentations.

In 2005, the State of California OES has also established a program called the "Public/Private Partnership for Emergency Management" (OES, 2008b). The goal of this program is to permit private-sector resources to augment the state's first-responders' resources during the initial days after a disaster to aid California's citizens and businesses. This program establishes formal relationships between government and the private sector to monitor resources controlled by the private sector, such as food and telecommunications, during disasters. A successful example of a public-private partnership was the effort also launched in 2005 called the "Be Smart. Be Responsible. Be Prepared. Get Ready!" campaign. The governor's family and OES, encourage residents in the state to be prepared for disasters. The campaign also includes a brochure in eight different languages titled "10 Ways"(OES, 2008c). This information is also anticipated to be expanded to incorporate business preparedness needs, as well as special needs populations.

EMERGENCY RESPONSE

Decision Making

The relationships that existed among local, State, and Federal agencies provided an excellent example of multi-agency cross jurisdictional cooperation and facilitated decision making. In a State as large and populous as California, cooperative efforts between local, State and Federal agencies were critical in the response to wildland urban fires (Campbell, 2004). Agencies worked together coordinating assets from neighboring fire stations and State resources.

Political boundaries were constantly crossed during the three-week event. Command, control and coordination processes were pre-planned under the command structure provided by the ICS and MACS. It was frequently the responsibility of the Incident Commander or local authorities to issue necessary evacuation orders. It was also notable that the cross-jurisdictional event extended across the border to Mexico during the emergency.

During the 2007 wildfire emergency, the California Governor declared a state of emergency in seven California counties (Archibold, 2007). These actions were followed by a federal emergency declaration in which both federal aid and military personnel and equipment were ordered to supplement state and local response efforts (White House, 2007). It was estimated that over 6,000 firefighters worked to fight the fires. In addition to the state and federal military units, these personnel were also assisted by nearly 3,000 prisoners convicted of non-violent crimes (Reuters, 2007), and 60 firefighters from the Mexican cities of Tijuana and Tecate (San Diego Union Tribune, 2007a).

On a local level, it was apparent that decisions of what areas to evacuation and when they should begin are made by the fire departments. Meetings with local officials showed that fire department officials designate where and when to evacuate based on knowledge and experience of wind conditions, fuel source availability, and threats to population. However, it was also clear that their job is to fight the fires. Thus, they are not heavily involved in the evacuation, although it was reported that firefighters did evacuate some people using fire engine when needed. The law enforcement agencies actually manage and control the evacuation process. If needed, some local DOT and DPW agencies play a minor overall in the evacuation by providing barricades, variable information signs, and closing roads.

Communications with Emergency Responders

Although the general conclusion was that the communication of emergency-related information to residents and evacuees was carried out effectively and some areas of need were identified in communication among the emergency responders (AAR, 2007), the overwhelming opinion was that communication was handled quite effectively from within and between the various responding agencies. Communications were said to not have been a problem and communication interoperability was relatively seamless. Another example of an effective tool in San Diego County were the web-based emergency management communication tools like WebEOC® software that made it possible for up to 500 agency representatives to have a complete, instantaneous, full situational awareness. It should, however, be pointed out that at times the fire moved faster than people's ability to get information into get system, update messages, have them read, and be able to use it in a useful fashion.

The City of San Diego After Action Report did identify some relatively minor issues associated with radio communications. This included a shortage of 800MHz radios among firefighting crews, that may have, at times, slowed the deployment of firefighters and equipment at various times and locations. Another issue was the lack of tactical channels for unit-to-unit communication. This limitation led to overcrowding on the available channels and the delay of information exchange at time when the bands were filled.

There was a lack of current map books reported in many areas. Detectives and administrative officers supporting the effort do not always have access to mapping or know how to use the software in patrol vehicles (AAR, 2007). Although an inconvenience, this was not reported to have delayed the response or affected the evacuation.

Communication with the Public

The City of San Diego report documented the level to which all available venues of communication were employed during the emergency, from quite sophisticated to the most basic (AAR, 2007), including:

- Door-to-door knocking by first responders and neighbors
- Police and Fire-Rescue vehicle sirens
- Police and Fire-Rescue vehicle and helicopter lights
- Constant monitoring and information flow to media outlets for dissemination to the public
- Emergency Alert System via television media
- Reverse 911® mass notification system
- AlertSanDiego mass notification system
- Community Access Phone System
- 211 Information Line
- Individual and community preparedness.

The Reverse 911® system was used effectively to distribute messages for individuals to prepare for evacuation and in many areas to issue mandatory evacuation messages. It was noted that many people relied solely on receiving a Reverse 911® call before preparing or evacuating their homes (AAR, 2007). All residents and businesses in an affected area with listed numbers were notified with the system. Individuals who registered their unlisted numbers as well as cell phones were also contacted. During the 2007 fires, the Reverse 911® system also called

teletypewriter systems and telecommunication devices for the deaf (TTY/TDD) for individuals with hearing and/or speaking impairments. The system is able to automatically redial numbers if it receives a busy signal, and leaves a voicemail if it reaches an answering machine. The system was said to have been timely and effective, although improvements are thought to be possible, particularly for phasing evacuations. While the system manufacturer claims that it can issue about 300,000 calls per hour, experience has show that outgoing call rates are function of the local telephone switching capabilities available in an office or telephone exchange.

A similar, though newer, system is the AlertSanDiego.com system used by San Diego County emergency management officials. The acquisition of this system was as a direct result of the 2003 fires. This is a web-based tool is similar to Reverse 911®, but may be better suited for evacuation because also incorporates a simple mapping tool within the software that can be used to prioritize calls to specific areas, rather than calling numbers within the database in numerical order. It can also use a computer generated voice to really typed messages. It can be accessed and controlled remotely via the Web, although caution must also be exercised in relying on it do to potential overuse of communication bandwidth during emergencies.

A community access phone system (CAPS) is available in San Diego to provide a direct information line to the public. Operators answered over 12,300 calls received through the system (AAR, 2007). In addition to CAPS, the State of California provides a 211 information line for the public to access community information from live phone specialists who answer questions about the non-profit services and agencies. Operators answered over 110,000 fire related calls in response to these fires (AAR, 2007). San Diego city officials also noted benefits of using 211 call systems to communicate with the public, particularly to relay general information. The system was useful most notably to relay non-emergency related agency contact numbers so that such non-emergency calls could go to these offices directly, instead of using emergency dispatchers to give out numbers or transfer calls to others.

Evacuation

Similar to most evacuations, the exact number of residents who evacuated, when they left, and where they came from and went to is not known for certain. However, several sources have suggested that the total number of evacuees during the event was near one million people, making it the largest in the history of California. Reports and interviews showed that evacuations orders were issued as both "mandatory" and "voluntary" during the event. The type of evacuation and when the orders were issued were a function of the speed and movement direction of the fires.

Although similar in many respects to evacuations for other hazards, wildfire evacuations, are somewhat different because they very fluid and based on the conditions of the event. The 2007 wildfires, as is common, had no set origin and pattern of movement. As such, there are no formally written evacuation plans, although a basic template of action does exist. These are not, for example, like hurricane evacuation plans that feature designated routes and formally declared temporal trigger points that govern when to initiate certain actions. The plans for wildfires basically involve a fire department's order of where and when to and the law corresponding law enforcement agency determining how best to carry it out. Some areas, like the mountainous regions of San Bernardino County, do have designated emergency routes inasmuch as they are the only routes out of the area.

Similarly, there are no written or formalized "phased" evacuation plans in San Diego or San Bernardino Counties. However, since the fire conditions do warrant the priority movement of some areas prior to others, phased evacuations have been affected by ordering certain areas to evacuate earlier and by using tools like the AlertSanDiego system to target earlier calls to the most threatened zones first. Although most evacuations started as staged, they were quickly were overcome by size and speed of the fire and became more general, large area evacuations.

There was no implementation of proactive traffic management techniques like contraflow or priority signalization during the 2007 fire event. In general, such actions seemed to be viewed somewhat negatively because of the additional control manpower they would likely require. Despite this, contraflow operations were seriously discussed for Ramona (north of San Diego) by local officials but, they were never implemented. In discussions with San Diego city officials it was learned that contraflow was used on a major roadway in the 2003 Cedar Fire also near Ramona.

Discussion also revealed that, at times, up to 15 major roadway routes were closed during the fires due to dangerous fire conditions. However, these closures did not appear to have impacted the evacuation. Most notably, all of the most heavily traveled highways of Interstates, 5, 8, and 15, were closed at different times. To address this situation, local officials worked with their federal counterparts at the Camp Pendleton Marine Corps Base to permit public use of on-base roadways for evacuation traffic to access northbound of I-5 in lieu of I-15.

Another general finding regarding the California evacuation was that the population tended to be more affluent and mobile than in other emergencies, particularly the Hurricane Katrina evacuation in New Orleans. Similarly the local population tended to be knowledgeable of evacuations; educated and aware of the potential dangers; and prepared to leave quickly with their most critical belongings.

Throughout the evacuation residents were encouraged to evacuate with their pets. The region around San Diego is well known for the equestrian facilities. The San Diego mounted patrol used their horse trailers to help evacuate horses out of the area.

Special Needs

Although the evacuation of threatened population proceeded relatively smoothly some issues associated with the movement of dependent and special needs populations during the 2007 wildfire event were noted. Access to a large nursing staff played a role in the successful evacuation of Pomerado Hospital and the adjacent nursing home (AAR, 2007). The City of San Diego After Action Report recognized that special need citizens tend to be under represented in the emergency planning and preparedness process (AAR, 2007). During the emergency it was found that some elderly and infirm groups experienced some difficulties in evacuating. A report documented the evacuation of 11 nursing homes that involved the movement of about 350-500 residents from nursing homes, assisted living centers, and independent living facilities (LA Times, 2007). Although the records do not indicate the details of their origin point or their health condition, four elderly San Diego residents were noted to have died during the evacuation. Of these, two of the decedents succumbed while being moved to safer medical facilities and two others past away at hotels where they were sheltering.

Another group that had been reported in the media to have been underserved during the fire was the migrant worker and Hispanic speaking population. The Reverse 911® calls that were used to notify the public were not conducted in Spanish, although local Spanish television networks did broadcast evacuation information. Some migrant workers in California were reported by some to have remained in agricultural fields even if the area was under a mandatory evacuation. The reasons for not evacuating were not provided. For non residents that did evacuate, some were denied entry at shelters because they did not possess adequate identification credentials. There were media reports of some individuals arrested because they did not have adequate identification. Although city officials pointed out that there were no reports of people not having evacuated because they did not understand that an evacuation was in place. The city's After Action Report did document a "chronic lack of translators, which hindered the ability to evacuate and/or provide other emergency services." (AAR, 2007).

Shelters

In addition to evacuees who made personal sheltering arrangements, residents from the southern California region also sheltered at numerous public evacuation centers throughout the region, including (AAR, 2007):

- QualComm Stadium (where an estimated 12 to 15 thousand people sheltered)
- Public Schools
- Civic centers
- Churches

The American Red Cross played a primary role in the establishment, support, and management of care and shelter facilities. It was noted that from the start of the emergency, large donations of food, water, cots blankets, and even children's toys began to arrive at care facilities, most notably the QualComm stadium. The significant operational areas required at the shelters included:

- Food management
- Donations Management
- Comfort Services
- Health and Special Needs
- Volunteer Management
- Animal Services
- Distribution Management
- Facilities Management
- Security

QualComm stadium was opened as a City run mega-care and shelter facility beginning on October, 22, 2007 (AAR, 2007). The facility received thousands of evacuees, special needs individuals, and animals. Approximately 400 nursing home patients created medical and logistical needs not previously experienced at the shelter (AAR, 2007).

During the wildfire emergency, all of the communities involved supported the evacuation of pets with the residents. In the San Diego and San Bernardino, officials set up "pet-friendly" evacuations shelters and even accommodated pets at QualComm stadium. It was estimated

that there were between 10,000-15,000 pets located in evacuation centers. The website Petfinder.com set up a 24-hour call center to link evacuees with volunteers willing to provide temporary homes for a displaced pet. Lists of pet friendly hotels were given for southern California. Typically hotels were allowing pets to stay at the hotels for no extra cost. San Diego Human Society and the SPCA provided information regularly on their websites about animal evacuation centers. At QualComm Stadium location provisions were also made to shelter large animals like horses.

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