Commission Briefing Paper 4E-03

Evaluation of the Potential Use of All Modes in Evacuations During Times of Emergencies

Prepared by: Battelle
Date: January 11, 2007

Introduction

This paper is part of a series of briefing papers to be prepared for the National Surface Transportation Policy and Revenue Study Commission authorized in Section 1909 of SAFETEA-LU. The papers are intended to synthesize the state-of-the-practice consensus on the issues that are relevant to the Commission's charge outlined in Section 1909, and will serve as background material in developing the analyses to be presented in the final report of the Commission.

This paper presents information on the transportation system's ability to utilize multiple transportation modes during an evacuation and an overview of support for local, State, Regional or Federal authorities in planning for and executing effective evacuations that utilize multimodal options in response to emergencies or disasters. This briefing paper emphasizes that the implementation of an evacuation from either manmade (intentional or unintentional) or natural disasters that effectively utilizes multiple transportation modes (multimodal) depends upon planning, resource identification and operational control by emergency response officials—including transportation authorities--at all governmental levels. In addition, the effective deployment of multimodal resources for an evacuation requires the participation of transportation managers in the private sector. This paper discusses the nature of disasters triggering an evacuation, the role of various transportation modes in evacuations, coordinating evacuation operations using various modes and the future role of multimodal transportation in evacuations.

Background and Key Findings

This briefing paper examines both the current role and future role of multimodal transportation in the conduct of successful evacuations. Modes of transportation discussed include transit (bus and light rail), inter-city buses, private automobiles, heavy rail, water transport, air and pedestrians.

One area that has often fallen short in evacuation planning for disasters is the use of multiple transportation modes. This is primarily for two reasons. First, many locations lack the multimodal infrastructure needed to support an evacuation. Second, the use of more than one transportation mode presents difficulties stemming from coordination problems among diverse organizations, resulting in challenges in assembling and committing transportation resources for a disaster. These problems are magnified by difficulties related to predicting the location and magnitude of a disaster. The paper also discusses approaches and techniques that are being employed to coordinate multimodal evacuations and ensure that multimodal transportation resources are used efficiently. As is the case for the other two briefing papers that address

emergency response transportation issues, the entire system must be working effectively to achieve success.

Key findings

- The effective use of multimodal transportation for a major evacuation increases the ability of transportation officials and emergency planners to successfully evacuate large numbers of people during a disaster
- Multimodal evacuations must be considered in a system wide context. Plans and operations must be designed to handle not only moving evacuees out of an area but emergency responders and supplies into an area
- Few plans recognize the role of multi-modal transportation as an evacuation tool and representatives of all applicable transportation modes must be involved in every stage of the evacuation planning and operations process. The use of multiple modes requires close coordination among a diverse group of public and private partners at both the embarkation and debarkation points
- The use of Public Transit will grow in proportion to the growth of the urban area
- Transportation officials must plan for multimodal evacuations far ahead of the actual need. Preparations may include such activities as developing alternative transportation modes or signing contracts with distant authorities or companies
- Transportation modes that may not ordinarily be considered for evacuation such as pedestrian evacuations should be factored into the multimodal mix where feasible as a viable means of moving large numbers of people to multiple embarkation points
- Technology can be used as a resource coordination tool and as a means to locate and direct emergency response vehicles.

.

Multimodal Transportation

The U.S. Department of Transportation issued the *Catastrophic Hurricane Evacuation Plan Evaluation: a Report to Congress* in June 2006. This report, which focused on evacuation planning in the Gulf States, points out that few plans recognize the potential role of intercity buses, airplanes and boats for use in evacuations. Furthermore, multiple modes do not play a prominent part in plans even in cities with a variety of available modes. Nevertheless, alternative modes are vital for evacuating those residents who are vacationing in an area; without their own personal transportation; are unable to drive; are classified as "special needs" and may be house-bound due to a disability; or are institutionalized in a nursing home, assisted care facility, group home, hospital or prison. With an ever increasing aged population and the cost of running and maintaining vehicles growing, more and more people are coming to rely on transit or other forms of transportation for their day-to-day mobility needs. As such, the ability to integrate multiple modes in evacuating populations is becoming more urgent.

The problems evacuating the population during and after Hurricane Katrina have reinforced the belief of emergency responders that multiple transportation modes are essential for a successful evacuation of the public for a city like New Orleans. The *Catastrophic Hurricane Evacuation Plan Evaluation* report shows that the city has developed a plan that places far greater emphasis on multiple modes for an evacuation. Their plan now identifies …"target groups that will be

evacuated by bus, railroad, and airplane, and how persons from each of these target groups will be transported to those modes." The report stresses that an important goal of the plan is to "create and maintain an environment where the decision to evacuate becomes more desirable than remaining behind."

Multi-modal transportation may also be key for a successful evacuation if damage occurs to one or a portion of one mode. For example, during earthquakes, the 2004 hurricanes in Florida, or the 2005 hurricanes on the Gulf Coast, major portions of the highway infrastructure were damaged. Furthermore, multiple modes provide a more rapid evacuation process as two modes may be able to operate on separate transportation routes as is the case with rail, light rail transit and ferry systems. Finally, even when the same route is used as would be the case with buses and personal autos, the buses can carry considerably more evacuees per lane mile than the personal vehicles.

The use of multiple modes needs close coordination not only between emergency managers and the transportation officials, but within the transportation sector itself. Most who use transit in their day to day lives use a combination of cars to and from a rail station, buses to and from rail stations, cars to and from bus or van pick up points, and even some inter-state rail or airlines for those traveling longer distances. When one of these options is unavailable to the commuting public, authorities must rapidly put alternatives in place. For example, during Hurricane Katrina rescue operations in New Orleans, police used boats to collect stranded passengers and take them to a location where they could take another mode of transportation out of the city. Transit options used day-to-day are not practical for many who have to flee hundreds of miles inland or away from an impact zone as is the case following or immediately preceding a major event. In this case, city assets aren't sufficient and must be supplemented.

The advanced planning required to ensure that the public has access to multiple transportation modes for an evacuation differs according to the mode needed and the ability of the emergency planners to access the particular mode. For this reason, it is critical that representatives of the various modes—highway, rail, motor carriers, transit, maritime and rail—are working together and with emergency planners to define various scenarios as well as roles and responsibilities. In those cases involving local transit facilities such as transit buses or buses supporting local school districts, agreements to supply vehicles may be easy to develop. On the other hand, for transportation resources that are not under the authority of the local political jurisdiction, more detailed agreements such as a memorandum of understanding (MOU) or a contract may be required. In order to develop these sorts of MOUs or contracts, the local planning agency may turn to the State or U.S. DOT for assistance. As the *Catastrophic Hurricane Evacuation Plan Evaluation* reports, agreements with outside transportation entities must be considered carefully to determine that the supplier is not making commitments to more than one urban area that will jeopardize their ability to deliver the required resources to assist in an evacuation.

Plans that are developed to use carriers from outside that area must include additional information that local carriers may not need. This information includes:

- policies on baggage and animals for the evacuation
- detailed maps of the potential evacuation areas
- maps of the proposed pick-up locations marked

- the location of routes to temporary shelters or transfer points on the maps.
- the location of emergency transportation procedures such as contraflow routes

As the result of the problems experienced during evacuations resulting from Hurricanes Katrina and Rita, the US DOT has been working with both the public and private transportation sectors to ensure the participation of multiple modes in an evacuation.

At a recent national conference on Managing Travel for Planned Special Events, numerous speakers identified multiple modes of transportation as the best way to move large numbers into and out of a venue. The speakers all represented governmental agencies or private concerns that deal with the movement of large volumes of people. It is worth noting that many agencies have realized the importance of multi-modal operations for special events and that its acceptance as a means to evacuate should be readily realized.

In addition, it is important that authorities consider how to use the modes to not only evacuate people from an area, but also bring responders and relief supplies into an area. During Hurricane Katrina, AMTRAK officials and the Federal Railroad Administration were frustrated that emergency responders were not using rail as a response mechanism to reenter affected areas. Equally important is the requirement to provide mass transit and logistics support at the receiving points away from affected areas.

Personal Vehicles

Despite anticipated spikes in fuel costs, personal vehicles will be the dominant mode used for most major evacuations in the foreseeable future, since it is viewed not only as a mode of transportation, but also as personal property to be protected. In many large urban areas, public transportation is under developed and therefore is not an option in evacuation planning. However, the use of personal vehicles creates major challenges that must be faced by emergency response officials. These include:

- multi-car families will evacuate all cars to safeguard them against damage or theft,
- the lack of private vehicle ownership among citizens who cannot afford a vehicle or choose not to own a vehicle,
- the inefficient use of vehicles carrying one or two people that are capable of transporting six or more people;
- the dissemination of information concerning who should be evacuated and which routes should be followed and
- the provision of feedback to drivers concerning such variables as contraflow routes, detours, and availability of fuel and rest areas.

As discussed in Paper IV-E-01, transportation officials must work closely with emergency response officials to address these potential problems associated with using personal vehicles during an evacuation.

Large population areas away from coastal zones have traditionally relied upon highway transportation to move large numbers of people. This trend is likely to continue. This could be changed if highway funding is replaced by transportation centric funding; where the most appropriate multi-use transportation funding is made available to specific regions.

The use of air travel will increase as a means of evacuation as more people relocate to distant areas of the country. These same people will chose their birthplace as a safe haven. As a result, evacuations will involve not just personal vehicle trips to a neighboring or more distant town, but may include car trips to airports. Even then, the public needs to know when airports will be closed for safety reasons. In the case of hurricanes, an airport may be closed 12 to 24 hours before the eye is expected to hit land.

Transit Buses and Rail

In addition to personal vehicles, transit buses and light rail are the most important modes that play a role in moving large numbers of people during a major evacuation, especially among people who use them on a day-to-day basis or are nervous about driving through hazardous or unknown conditions. Local transit buses and trains that are within the jurisdiction of a particular metropolitan area can be incorporated into emergency evacuation plans. However, if the resources of transit agencies outside of the urban area are needed to assist in evacuations for catastrophic evacuations, additional programs must be in place. One program, the Emergency Response and Preparedness Program, (ERPP) is a voluntary mutual plan sponsored by the American Public Transportation Association (APTA). The program is designed to assist other transit systems and their cities, regions and states with emergency evacuation and temporary transit operations that may be required during an emergency. For this program, the Federal Transit Administration (FTA) has partnered with the APTA and has provided resources to support the system. There are currently 172 transit agencies signed up for the program which is scheduled to become operational in May 2007. This program should make available transit buses and their drivers to assist both neighboring communities and other communities in the region. If the program is successful, those populations in a disaster area that are transit dependent will be able to more easily gain access to buses during local evacuations.

Light rail and especially subway systems in major cities are essential for moving large numbers of people. This was demonstrated in both New York City and Washington D.C. on September 11, 2001. In Washington D.C, the attack came early in the day towards the end of rush hour. Consequently, the authorities were able to continue the rush hour level of service and move large numbers of people out of the city. However, good communication is needed for many who don't use the system regularly. An integrated logistics approach needs to be incorporated into all multimodal evacuation planning to accommodate those contingencies associated with an evacuation. For example, how do you transport those people who drove to work but were forced to use public transit from a bus stop or a rail station to their homes? Furthermore, transportation officials must prepare for the contingency that a large percentage of transit operators may be unavailable during a disaster. These employees may need to evacuate their families and do not see themselves as first responders. This means that agreements with neighboring communities will be important to get personnel who don't work with the equipment or the system regularly to fill in for those who need to evacuate their families or safeguard their homes.

Over the Road Buses

Another program directed at providing additional evacuation capability has been initiated at the US DOT to provide over-the road buses for long distance evacuations. Through a contract with the Federal Motor Carrier Safety Administration (FMCSA) and U.S. DOT, Coach America - a private passenger carrier - has a contract in place to provide buses for evacuations during and immediately after a disaster. The contract extends through June 2007 but is likely to be extended through the next hurricane season. Under the contract, approximately 400 buses would be staged for immediate use in Louisiana with a total of 1500 that could be called upon at DOT's direction. These buses would likely be used to evacuate citizens from a city like New Orleans to reception centers up to 250 miles away. The program was established for the 2006 hurricane season but has not yet been implemented.

States can also implement their own agreements to supply over-the-road buses. Before the 2006 hurricane season, the state of Texas established its own program to provide buses for evacuations. Texas signed contracts with private bus companies to have available up to 1,100 buses for evacuations. Careful coordination is required to assure that a service provider is not being contracted by multiple jurisdictions that may need these services at the same time.

Although these sorts of agreements represent innovative, proactive actions, the downside is that they may takes assets and priority decisions out of the hands of local emergency managers. For example, if buses were needed in Baton Rouge, but New Orleans had a hold on them, the bus company may break the "stand-by" to sell its services at a higher rate to Baton Rouge or the State authorities would have a resources taken from them by a local jurisdiction that is not allowing the company to release the buses in case another storm hit New Orleans in the near future.

Heavy Rail

Passenger trains can play a critical role in evacuation of people during a disaster. Unfortunately, coordination between railroad officials and the local emergency operations officials has not always worked as smoothly as desired. During the buildup for evacuating residents from New Orleans during Hurricane Katrina, Amtrak offered to help by sending a train with capacity to move 900 people. A day and a half before the storm hit, their offer to help was turned down and the train left the city without any passengers aboard. Note that Amtrak did send another train after the hurricane that evacuated 96 people from New Orleans to Shreveport. During Hurricane Rita, several railroads including BNSF, Amtrak and Trinity Railroad Express coordinated equipment to put together a train that evacuated 450 people from Houston to Dallas. Trains did play an important role in the emergency response effort for Katrina by bringing in supplies and equipment after the storm. FRA controls the resources for Amtrak and has access to ample capacity (passenger equipment) to ensure that transit users can evacuate from a community. After Hurricane Katrina, Amtrak signed a contract directly with the Louisiana DOT to provide the equipment to move 15,000 people during an evacuation precipitated by another major hurricane. During the 2006 hurricane season, Amtrak staged in New Orleans ten trains with 24 cars and each car with the capability of moving 80 people. Amtrak does not have any similar contracts in place with other states.

Heavy rail can play a much greater role in evacuations in response to catastrophic disasters. It has the ability to move large numbers of people without adding congestion to the roadways. However, it is incumbent on the state and local emergency response officials to develop contractual agreements with service providers before a disaster hits.

Many major American cities do not have scheduled passenger train service. Residents in cities with scheduled service that are transit dependent are far more likely to be able to take advantage of this mode during an evacuation. Residents would have the option of taking a train to leave an area before a potential disaster arrives. Furthermore, service providers could more quickly mobilize their equipment and respond to a major disaster more rapidly. The expansion of passenger train service to additional cities would enhance the effectiveness of multimodal evacuations especially in the early stages of a potential disaster.

As we see, an increase in imported goods, and the resulting increased capacity of intermodal operations, a greater demand will be placed on existing railways. Coastal areas most susceptible to catastrophic events are also most likely to house large intermodal facilities. Railways are usually owned and operated by private concerns. The need to move large populations away from coastal areas will depend on the government's ability to identify and 'set aside' track space for passenger rail responding to catastrophes.

Multimodal transportation, including their personnel and equipment, must be incorporated for the effective functioning of the logistics, planning and operations support process. Coordinated, multi-modal evacuations require a number of elements including: staging areas, transportation to and from staging areas, shelter destinations, coordinating evacuee pick-ups from a mode and moving them to a shelter or other designated reception site. The evacuation process must be considered as a system to function effectively. The use of AMTRAK trains In Louisiana after Hurricane Katrina illustrates this point. AMTRAK transported people via train but found that the evacuees were not allowed to disembark at certain locations because local officials would not accept evacuees. Consequently, people had to ride the train until they were allowed to disembark. Once they disembarked, there was no one to transport them to where they needed to go. This example shows that logistics at the debarkation point is just as important as the logistics at the embarkation point.

Aircraft

Aircraft and especially helicopters played an important part in the evacuation of citizens in New Orleans after the storm hit and most people had evacuated. These helicopters were operated primarily by the cost guard and the military and were employed to rescue people stranded in flooded areas. Cooperative agreements similar to the one between the DOT and Coach America should be made with flying services to supply helicopters and fixed winged aircraft in advance of large scale evacuations. The fixed wing aircraft would be especially valuable for evacuating special needs people with serious medical conditions. Commercial airports must also maintain a 'steady-state' of preparedness and be capable of providing a full range of services with little or no notice.

Ferries and Other Waterborne Transportation

Ferries and other waterborne transportation are one transportation mode that has played an important role in evacuations of several cities. For example, during the Northeast blackout, subways were not running in New York and roads were in gridlock. Thousands of people were able to get to the Hudson River and take a ferry to cross over to New Jersey. Similarly, on 9/11/01, evacuation by water was important as the ferry services and tour boats were used to evacuate lower Manhattan. For cities such as New York, Seattle and San Francisco that have ferry service, that mode is available to be used during evacuations. There are cities located on the water without (or with limited) ferry service that could use ferries as an additional mode for evacuations during certain types of disasters. These cities, such as Philadelphia, Miami and Chicago, could use ferries (and perhaps tour boats and other ships) to assist in evacuations. Note that there are precedents for using larger cruise ships for evacuations. In Lebanon during the summer of 2006, the United States employed cruise ships to evacuate thousands of Americans stranded during the war.

Smaller boats may also prove to be critical. After Hurricane Katrina struck New Orleans, thousands of New Orleans citizens were stranded in their homes, unable to leave because of the flood waters. Hundreds of small boat owners trailered their craft from surrounding Louisiana parishes to assist in the rescues and evacuations. Another group that responded to the crisis with small boats was professional state personnel such as game wardens, park employees and natural resource professionals.

Technology to Enhance Multimodal Evacuations

The coordination of multimodal transit systems as well as vehicles within a particular system can be facilitated by maintaining a real time location and status of the vehicles before, during and after the emergency at an emergency operations center (EOC). Emergency operations coordinators, as advised by transit officials and other transportation officials, can collect and develop this information through use of a Global Positioning Satellite (GPS) tracking system placed on each vehicle involved in the evacuation. Using this technology, the operations officials will know not only where the vehicle is but be able to determine its movement. This information coupled with radio and/cell phone contacts will provide the data needed to make adjustments in the movement of the vehicles based on such cases as extreme traffic tie ups, infrastructure destroyed or diminished by the disaster, or changing needs to pick up passengers at a pick up location. Examples of the application of GPS systems are found in Corpus Christi and San Antonio Texas. San Antonio and its surrounding Nueces County, along with fire companies at several private sector refineries, have installed GPS systems for Automatic Vehicle Location (AVL) on all of their Police, Fire, EMS, Sheriff, fixed route transit and paratransit vehicles. The vehicles are displayed at the EOC and enable the staff to control these vehicles. In San Antonio, the buses are equipped with GPS systems that would enable them to be tracked during an evacuation.

Tracking devices would also be useful for coordinating the movement of light and heavy rail as well as passenger carriers and would provide the EOC with the location or trains and ferries that would be used to track vehicle locations and adjust to changing conditions during an evacuation.

The installation of security cameras at intersections is an example of one technology that enables the smoother functioning of a multimodal system and allows EOC personnel to monitor traffic. In New York City during the evacuation, transportation officials had to physically inspect intersections to make deployment of resource decisions. Since 9/11, cameras have been installed at critical intersections that should aid the officials in monitoring the roadways if a future evacuation is needed. Multimodal operations centers provide maximum efficiency to coordinate resources during an evacuation. This center includes technologies that tie into the particular modes that would be involved in an evacuation. For example, in Montgomery County Maryland, a center was established that contains a centralized computer-aided bus dispatch and traffic signal control. The initial collaboration occurred between two divisions of the Montgomery County Department of Public Works and Transportation that had responsibilities for road operations and transit services.

Pedestrian Evacuations

Evacuations of pedestrians have clearly been used as a total or partial method of evacuation. Examples include evacuations on September 11, 2001 in both New York City and Washington D.C. These and other examples of pedestrian evacuations are included in a 2006 FHWA report entitled *Managing Pedestrians During Evacuations from Metropolitan Areas.*

Pedestrian evacuation must be managed to ensure their safety, minimize the possibility that they contribute to traffic congestion; keep separate vehicle and pedestrian routes; or reduce the pedestrian routes as the evacuation progresses. Separating people from vehicles is exceedingly difficult when dealing with large number of people moving in the same direction. Large numbers may easily take over a street and make it difficult for any vehicle with the exception of emergency response vehicles to pass.

In response to 9/11, several emergency response adjustments were made. These adjustments include but are not limited to: installing cameras at critical intersections; participation with other agencies to provide information, education, and alternatives to the public in order to avoid contributing to traffic congestion; use of Citizen Emergency Response Teams (CERTs) that were formed to educate the public and assist them with the subway system during an evacuation; and use of a Regional Incident Coordination and Communication System (RICCS) that was developed for the District, Maryland and Virginia regions as a central point for collecting and broadcasting information.

Federal Involvement

The National Response Plan defines the concept of operations for coordinating delivery of Federal assistance and resources to State and local governments overwhelmed by a major disaster or emergency. The NRP identifies the Department of Transportation as the primary agency in Emergency Support Annex #1-Transportation. In the local disaster area, direction of the federal transportation response is provided by the DOT Regional Emergency Transportation Coordinator (RETCO). The RETCO is responsible for coordinating the Federal transportation response activities within the assigned jurisdiction. The RETCO will activate elements required to meet the demands of the disaster, including representation to the Regional Operations Center, Emergency Response Team, and the field Movement Coordination Centers. A designated Emergency Coordinator in each FHWA division office supports the RETCO, provides situation

information back to Headquarters, and coordinates the FHWA-portion of the response in the disaster area.

Conclusion

This briefing paper has examined the current role and future role of multimodal transportation in the conduct of effectiveness and successful evacuations. Multimodal transportation is key to successfully evacuating the public during major disasters. The most effective approach for achieving the use of multiple modes is for emergency response officials at the local, regional, State, and Federal levels to actively incorporate multiple transportation modes in their evacuation plans and then to develop agreements with a variety of modes in the public and private sector to be ready to respond to emergency evacuations. Planning and contractual agreements to ensure an adequate supply of multimodal resources apply to all areas of the country with the reasonable chance of experiencing either a major natural disaster or a catastrophic terrorist attack.

CONSOLIDATGED COMMENTS FROM MEMBERS OF THE BLUE RIBBON PANEL OF TRANSPORTATION EXPERTS - PAPER 4E-03

Several reviewers combined their comments as follows:

Many of the previous comments on Papers 4-E-01 and 4-E02 also have direct applicability on "potential use of all modes" similar to "evacuation" and "redundancy".

Special direct coordination with DoD in terms of any military utilization of facilities is required to optimize potential effectiveness of all modes.

Special consideration of evacuees when they reach planned destination must be integral. Lessons learned from Katrina shortcomings must be integrated to avoid secondary potential problems.

The paper states that "few plans recognize multi-modal transportation as evacuation tool". If so, this should be stressed for further focus.

Safe pedestrian evacuation is also critical and must not be taken for granted. As an example on 9/11 many people used railroad tracks for DC evacuation - clearly unsafe and difficult to prevent or manage without extensive advance public information program.

During weather related evacuations, certain operators (such as freight rail dispatchers, school bus drivers, etc.) may evacuate without redundant provisions.

The public must be fully involved in advance evacuation planning, and strongly encouraged to develop their own personal plans consistent with the regions overall plan.

USDOT should be responsible for "brokering" all transportation evacuation planning. There should be more focus on mitigating the impacts of utilizing personal vehicles and identifying alternatives.

Contingency evacuation plans should recognize the "loss" of a particular mode or key system link. It is important to field test the practicality of alternative modes/facilities handling the overflow.

Training exercises must include on the ground operators, first line responders and others to agree on protocols for command and control.