

Authority (MTA), City of Houston, and SDHPT to work together closely in developing traffic surveillance control and communications (SC&C) systems for eight freeway corridors. This will include Authorized Vehicle Lanes within the freeway median areas, freeway control and surveillance, and frontage road and corridor street traffic-responsive traffic signal control along each corridor.

Conclusion

Corridor (Traffic) management teams can be of benefit to many cities. Over half the population in the United States lives in 39 metropolitan areas of over one-million population. Also, 90 additional metropolitan areas have populations between 300,000 and 1,000,000.

Corridor (Traffic) management teams have proven to be very useful in increasing communications, cooperation, and coordination; they have also permitted cities to focus on problems with the combined expertise and funding capability of the many governmental and public transportation agencies involved in traffic operations within the urban area.

Carl Braunig, the former traffic engineer (now retired) in San Antonio, once said that the Corridor management team reminded him of a popular beer advertisement that read "Try It, You'll Like It." Carl said he tried the Corridor management team and sure enough, he liked it. Why don't you try it; you'll like it, too.

POLICE PERSPECTIVES ON TRAFFIC MANAGEMENT OF FREEWAY EMERGENCIES

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As the state's primary traffic law enforcement agency, the California Highway Patrol is responsible for providing traffic services to 23 million residents on over 96,000 miles of highways. In addition to traffic management duties such as routine patrol, emergency incident response, assistance to motorists and accident investigation, the Department also has responsibility for the regulation of hazardous materials transport, auto theft investigation, emergency medical services, and dignitary protection services. The State Legislature has designated the Highway Patrol as scene manager for any hazardous material incident occurring on highways under its jurisdiction. The Department also serves as the Statewide information, assistance, and notification coordinator for all hazardous material spill incidents occurring on highways and functions as State Agency Coordinator for highway spills.

The 16,000,000 motorists and complex roadway network in California make it imperative that freeway emergency incident response planning be effective and comprehensive. Comprehensive planning efforts are essential in each of the following areas in order to ensure successful management of freeway emergencies:

- Timely Response
- Scene Management
- Traffic Coordination
- Multi-Agency Communication and Coordination
- Training

Each of these areas is vital to the successful management of emergency incidents, from the most basic fender-bender to the most complex and disastrous major collision or hazardous materials incident. One of the most important considerations in planning efforts is the containment of any incident, since adequate preparation can prevent the escalation of any occurrence into a major problem.

Timely Response

Timely and appropriate response to freeway emergencies is the first step in getting the scene under control. Procedures should be established to ensure all requests for ambulance, rescue, and other emergency equipment are responded to immediately by the appropriate agency. Dispatch of personnel and equipment should occur immediately upon receipt of reasonable information that a particular need is present. It should be the responsibility of the scene manager to assess response needs and adjust resources accordingly.

Scene Management

Scene management implies general and comprehensive oversight of all operations that occur at the location of an accident or emergency incident. The scene manager assesses the scene and determines what needs to be done; i.e., parking of emergency vehicles, priorities of conflicting tasks, opening and closing of roadways, etc. Responsibilities include:

- safeguarding those at the scene, the motoring public, and all other potential victims on or off the highway;
- maintaining an awareness of the potential danger to surrounding land, air, and water and considering what steps should be taken to mitigate that danger;
- managing operations at the scene in a timely and professional manner.

CHP officers are directed to assume scene management responsibilities immediately upon arrival in order to alleviate confusion and increase effectiveness. Other response agencies are consulted at the scene to ensure proper utilization of resources.

Traffic Coordination

With respect to traffic coordination during emergency incidents, it is necessary that road conditions be properly evaluated and reported; that traffic control be initiated immediately to eliminate danger to emergency response personnel as well as to motorists; and that procedures be established to prevent unauthorized entry into the incident scene. The scene manager, in conjunction with other responding agencies, should determine the extent of needed traffic control; i.e., lane closure, freeway closure, rerouting of traffic onto local streets, etc.

Multi-agency Communication and Coordination

Coordination of multi-agency resources can be accomplished through written statements of understanding and interagency agreements. Agreements should be formulated so that a clear understanding is established regarding each

agency's organizational authority, areas of responsibility, and response and equipment capabilities. In addition, all procedures and operational capabilities of involved agencies should be publicized within each planning area, to ensure that all personnel are made fully aware of available resources and expertise.

Upon arrival at the scene of major incidents, the responding officer should establish a Command Post at the best location for observation of operations and coordination with other agencies. The Command Post can be identified by placing a distinctive flag on an enforcement vehicle antenna. The use of the Command Post as a central information source can reduce confusion and delay, and improve press relations and interagency communications.

One of the methods employed by the CHP to enhance its scene management capabilities is the use of Emergency Incident Management Vehicles (EIMVs). These vehicles are used to respond to emergencies caused by major traffic accidents, disasters, significant hazardous materials incidents, and similar major events. The vehicles, which function as a Command Post location, are fully self-contained motorhome-type vehicles, equipped with wall-mounted desks, a conference table, chairs, bookcases, and sophisticated communications equipment. Also included is an assortment of manuals and reference materials, a portable public address system, mobile telephones, modular telephones, and wind direction/speed indicators.

Training

Training is one of the key elements of emergency incident response, particularly interagency hazardous materials response training. The Department's training program includes emergency incident response, scene management, and after-incident follow-up for new officers, field supervisors and managers. The CHP also conducts hazardous materials spill training for cadets, in-service officers, and sergeants, as well as conducting a statewide interagency training program for California police and other first responders. This training was developed as three modules in order to provide differing levels of instruction for the various personnel who might be involved in hazardous materials incidents. Module I consists of an eight-hour basic awareness course and is geared for officers and sergeants. Module II is designed primarily for sergeants and concentrates on the specifics of on-site tactical problems. Module III is geared for command-level personnel and is an advanced course covering scene management, use of resources, planning considerations, and post-incident evaluations.

Emergency Incident Management

Of the various types of freeway emergencies handled by the Department, some require more extensive planning and coordination than others. Based upon interpretation of various statutes, the Highway Patrol defines "Emergency Incident" as any unplanned event that results in an interruption of traffic flow and causes actual or potential property damage, injury, or loss of life; and that necessitates the mobilization of various emergency service elements to alleviate the incident and restore order. This definition is used in all the interagency training conducted statewide to ensure uniformity. Major freeway accidents and hazardous material spills place the maximum demand upon

Department and allied agency resources. However, all incidents are of concern to us, not only because of the possible injuries, loss of life, and property damage, but also because of the possibility of hours of freeway downtime. Lane closures can result in numerous hours of motorist delay, which can translate to a substantial cost to the public. For example, in a recently completed study, the CHP developed an estimate of cost per hour of motorist delay in Los Angeles, Ventura, and Orange Counties as of January 1984. The value of motorist delay is estimated at \$8.83 per hour, with 1,300,000 estimated hours of motorist delay documented due to truck-involved accidents between January 1979 and May 1984. This totals approximately \$11,500,000 lost to the public over the 65-month period.

San Ramon Hazardous Material Spill

The following is an example of a freeway emergency incident that occurred in California. The incident is described in detail; analyzed for appropriate response and handling; and discussed with respect to the operational problems that occurred.

The San Ramon Incident occurred at noon in September of 1981, on Interstate 680, a six-lane north/south freeway in Contra Costa County. The average daily traffic volume on this roadway is 91,000 vehicles. The area is moderately populated (Est. 693,670), with several communities including San Ramon adjacent to the freeway. At the time of the spill, a multi-agency preplanning effort was underway in the County, but had not been completed. This lack of a finalized Emergency Incident Plan contributed to the operational problems that occurred in handling the incident.

An agricultural checkpoint was being conducted in San Ramon on a random basis to check for possibly contaminated fruit being taken out of the area. As a vacuum tank truck pulled slowly through the inspection lane, two Department of Agriculture officers observed that it was leaking a liquid substance and emitting an orange-colored cloud from the rear of the trailer. The truck was stopped by CHP officers and the shipping manifest examined. It was determined that large quantities of extremely toxic and hazardous corrosive acids such as nitric, sulphuric, hydrofluoric, and hydrochloric acids were present, as well as acetic acid and several heavy metals.

As a result of the leak, a potentially lethal cloud began to spread toward a residential area about 0.4 miles east of the spill. Upon arrival of the CHP shift supervisor, a Command Post was established 0.4 miles south of the spill on northbound 680. Traffic control was established at major intersections, stopping or diverting vehicular traffic in the immediate area.

Because of the toxicity of the gas and the proximity of residential development, it was determined that the immediate area (one square mile) should be evacuated immediately. The evacuation was handled by the Contra Costa County Sheriff's Department at the direction of the Scene Manager. In addition to the CHP and Contra Costa County Sheriff's, 30 other agencies responded to or were involved in handling the incident. These agencies included the California Department of Transportation (Caltrans), police, fire services, hospital services, ambulance services, and hazardous material cleanup companies.

This incident illustrates many of the problems that can occur when preliminary planning for emergency incidents is incomplete. One of the major problems encountered was the organization of the evacuation by the Sheriff's Office. The area is primarily residential and contains several primary schools. However, neither the school district nor the county had conducted evacuation planning or training. There was no evacuation plan for the community as a whole or for the individual schools. This resulted in several mixups regarding who to notify and where the children and adults should go. Media reports of the incident added to the concern of parents who rushed to the school but were unable to locate their children. At one point, some of the children being evacuated were sent in the wrong direction, toward the poisonous gas rather than away from it. The evacuation site also was changed in the middle of the operation so many parents could not locate their children. In some cases, neighbors had already transported groups of neighborhood children but since no record was kept of which children were released or to whom, there was a great deal of confusion and concern by parents.

The media, in an effort to provide up-to-the-minute reports, obtained information from sources other than the Scene Manager. This resulted in the broadcasting of inaccurate information on several occasions. On-scene personnel also had difficulty controlling media access to the area, causing danger to media and emergency personnel, as well as creating interference with on-site operations. For example, at one point a media helicopter hovered directly over the tank truck in order to obtain better footage, thereby dispersing the gas into the Command Post area. The Command Post had to be moved to another location as a result. The Helicopter crew were overcome by fumes and made an emergency landing on the freeway, further adding to the emergency.

The following are some of the conclusions reached as a result of the after-action examination of the handling of the San Ramon spill.

Planning

The county did not have a finalized plan for handling hazardous materials spills. Evacuation plans were either nonexistent or incomplete, with no provision for specific evacuation sites. Self-contained breathing equipment necessary for the safety of emergency response personnel was not available. Methods to ensure collection of potential evidence had not been established, which could have created substantial problems in the event of any liability suits.

Timely Response

Response to the scene occurred within minutes of notification that a problem existed. Initial observation of the orange cloud and leak from the tank truck occurred at 1205 hours; the Command Post was established by the Scene Manager at 1232 hours. In the intervening 27 minutes, I-680 was closed; traffic control established; the Sheriff's Office, Caltrans, fire personnel, the county office of Emergency Services, IT Corporation (chemical spill identification and cleanup company), and additional CHP officers all responded to the scene; and air traffic control over the scene was established.

Scene Management

Scene Management was handled by the CHP shift supervisor. Command Post operations suffered from a definite lack of personnel and the availability of on-site communications capabilities. This could have been avoided through the use of the Contra Costa County Sheriff's Office communications trailer; however, due to lack of planning, there was no trailer hitch available to haul the trailer to the site until the incident was nearly over. Controlling some media personnel's access to the scene also proved to be almost impossible.

Traffic Coordination

Traffic control was established almost immediately, with the occurrence of only one minor problem. Due to a communications mixup, an officer assigned to control traffic left his post, resulting in traffic temporarily being allowed to move toward the Command Post location and past the leaking vacuum truck. This problem was rectified immediately and alternate traffic routes established and maintained throughout the incident.

Multi-agency Communication and Coordination

Allied agency personnel were available at the Command Post for immediate coordination with the CHP Scene Manager throughout the incident. Cooperation with involved agencies at the Command Post was excellent, as were communications between on-site personnel. However, there were problems with off-site allied agencies. Information was being disseminated through too many agencies, resulting in confusion and the release of erroneous information. The media, while a valuable resource for dissemination of emergency information, also caused confusion and created problems at the incident scene.

Management of reporters at the Command Post and the spill scene was a full-time job for the Contra Costa Area Public Affairs Officer (PAO). On several occasions, the PAO was required to respond to the spill scene, away from the Command Post, to instruct media personnel to evacuate the area. They had climbed over the perimeter fence, walked to the spill site, and were interfering with cleanup operations. In addition to creating a health hazard to themselves, others were placed in danger because of their actions.

In the temporary absence of the PAO from the Command Post, some media personnel removed their identification and milled around the Command Post, attempting to obtain current information. Command Post security was lacking.

Media helicopter involvement caused extreme danger to all on-site personnel. The Federal Aviation Administration, Buchanan Field, Concord, was advised of the problems being experienced and was requested to restrict all air traffic in the surrounding area. The media helicopters, in spite of FAA instructions, continuously flew above the spill scene. One helicopter circling the toxic cloud flew directly over the leaking tank truck causing downdrafts and blowing of the toxic cloud in the spill area while fire personnel were attempting to determine the exact area from which the vacuum trailer was leaking.

Training

At the time of the spill, Contra Costa Area personnel had completed the initial eight-hour hazardous materials awareness course. The second portion of the training, concentrating on on-site tactical management problems, had been planned but had not yet been presented. It was determined by the After-Incident evaluation that there was insufficient internal and external training in the management of a complex hazardous material spill incident. Since that time, the training situation has been rectified with the completion of the third portion of training for both Departmental personnel and allied agencies.

Summary

The successful management of emergency freeway incidents in California is dependent upon effective planning for use of multi-agency resources. Through legislation designating scene management responsibilities and through open communications between the CHP, Caltrans, and local fire, police, and other emergency response agencies, California has developed a high degree of cooperation in handling these incidents. The CHP and Caltrans meet regularly on an informal basis in order to resolve problems as they occur and to maintain clear lines of communication regarding multi-agency responsibilities. In addition, the statewide multi-agency training conducted by the CHP for police and fire personnel has contributed substantially to successful cooperation and coordination among responding agencies.

REAL-TIME TRAFFIC CONTROL FOR MAINTENANCE WORK ZONES

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Introduction

Between 1979 and 1981, the need for remedial work on Houston area freeways (particularly those over twenty years old with traffic volumes near 200,000 vehicles per day) increased markedly. Complaints from the public about traffic jams caused by such work led to one legislative suggestion that all freeway work in the Houston area be limited to night operations. This did not pass, but led to work zone operations being restricted to nighttime hours and weekends. It is during these time periods that speeds are high and the chance for errant driver behavior increases. In 1980 and 1981, 12 highway workers were killed and 34 injured while working on Houston's freeways. Most of these casualties were caused by drunk drivers and speeding motorists.

The Problem

With almost 600 miles of state-maintained roads in Harris County and work predominantly restricted to weekends, the rate of maintenance activity had fallen far behind the needed rate. This situation became increasingly critical with funding limitations and extensive red tape facing the initiation of major roadway rehabilitation efforts. In the spring of 1982, the State District Office decided a means for performing maintenance operations on even the highest-volume roadways during the previously restricted hours must be found. The objectives of this strategy were threefold:

1. Allow time for the needed remedial maintenance to be performed.
2. Insure worker safety.
3. Prevent intolerable delay to the traveling public.

Deployment of Special Traffic Handling Crew

Research studies have been conducted (2, 3, 4) on "traffic management type" capacity improvements for work zone operations. These have included the temporary use of shoulders as a travel lane, modifying intersection signal timing, encouraging traffic to divert to alternate routes, and closing entrance ramps within the work zone area. Some of these measures have been successfully implemented on major rehabilitation efforts on the Edens Expressway in Chicago and the Gulf Freeway in Houston. However, these techniques have been used only on a limited basis for short-term operations.

A specially trained crew was formed and assigned the task of handling traffic during maintenance operations on high-volume roadway pavements, thereby increasing the hours available for maintenance activity. The crew has the authority and capability of implementing proven work-zone traffic management techniques (in a manner consistent with the "Manual of Uniform Traffic Control Devices"). A major advantage of the special crew is its ability to actively manage traffic during the maintenance operation.

Prior to this, a traffic control plan was prepared based upon traffic flow-rates through a proposed work zone. The traffic data indicated the number of lanes needed to minimize motorist delay. Shoulder signing would be deployed at the outset of the operation and remain until the operation was complete.

With the special crew, the traffic control plan would be modified to react to changing traffic conditions. Excessive speeds adjacent to and in the work zone is a contributing factor to accidents. The use of the shoulder to provide additional capacity at work sites may actually contribute to speeds higher than desirable during "lulls" in traffic and thus compromise worker safety. The crew could react to this situation and "turn off" the shoulder-use signing, thus lowering speeds. This method of handling traffic has been termed "Active Traffic Management."

The District Office tried the special crew concept on an experimental basis. An urban freeway in Houston carrying 175,000 to 200,000 vehicles per day was badly in need of pavement repair and rehabilitation; but a major contract could not be let for several months. Some of the needed repairs were critical, but high traffic volumes precluded use of typical maintenance techniques. Interim repairs were needed and this site provided the first test for the special traffic handling crew.

Individuals experienced in traffic management techniques were asked to handle traffic while the interim maintenance was performed. A job of this magnitude normally would have required at least two months if work were restricted to Sunday mornings. Workload analysis showed that working Monday through Thursday during daytime off-peak hours for two consecutive weeks and one weekend would provide enough time to make the interim repairs. This schedule required three road-work crews to be available to work simultaneously. Motorist delay