Assessing Hazardous Materials Emergency Response Capability: Methodological Development and Application

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The emergency response community is facing important challenges in the current economic, political, and technical environment. Mandated requirements combined with tight budgets are necessitating the use of innovative techniques to meet the needs of emergency response planning and management, particularly for hazardous materials incidents. As public awareness of the manufacture and transport of hazardous materials increases, the demand for adequate emergency response related to these activities has become more focused. The complexity of possible consequences due to hazardous materials incidents and the need for responder awareness of these consequences have led to a need for a systematic approach in evaluating the capabilities of responders. The development and implementation of such an approach are described. A matrix of different response capability levels for varying types of hazardous materials incidents is presented along with the corresponding methodology to evaluate emergency responders. This provides responders, elected officials, shippers, and carriers with the ability to assess the current level of preparedness, evaluate the level of preparedness desired, and develop a cost-effective means for attaining that level. The resulting methodology provides a uniform procedure for evaluating hazardous materials emergency response capabilities at the local, regional, and national levels. The basis for this work has the potential to be expanded to any emergency response evaluation (e.g., flood or hurricane) and to real-time management of emergencies.

Increased concern for public safety and environmental awareness have brought about a need for improved practices to adequately plan for and manage emergencies. An emergency, as defined in this context, is an unexpected event of limited duration that can adversely affect the surrounding area and population. Whether natural or induced by society, these events typically involve several factors, from identification to cleanup, and normally require interaction and cooperation among numerous public and private entities.

The management of an emergency has four major components: (*a*) identification of the nature of the emergency, (*b*) evacuation and rerouting of the population at risk from the affected area, (*c*) containment or isolation of the incident, and (*d*) cleanup and mitigation of the effects of the emergency. Emergency response relates to all of these components either directly or indirectly.

Among the types of emergency events, hazardous materials incidents have taken a prominent position. The manufacture and transport of hazardous materials have been subjected to increased public scrutiny because of the threat to health and safety that a major incident could create. If emergency response is timely and qualified, the incident may be controlled before any serious consequences occur. However, as additional time elapses, the likelihood of more serious consequences increases, potentially leading to injury, death, and loss of productivity. Thus, the essence of effective emergency response is to minimize the consequences of an incident when one occurs.

EMERGENCY RESPONSE PLANNING

Effective emergency response requires planning and is mandated by existing legislation. The Superfund Amendments and Reauthorization Act of 1986 (SARA) requires each local emergency planning committee to prepare comprehensive hazardous substances emergency response plans, primarily for facilities. Likewise, the Hazardous Materials Transportation Uniform Safety Act of 1990 was enacted to provide guidance to enhance state and local hazardous materials emergency planning and training for transportation. Similar legislation addresses specific responses for incidents such as oil spills. The two laws and their supporting documentation have provided guidelines for establishing emergency response plans. However, a systematic approach is still required to effectively implement these plans.

To have an effective plan, several information elements are needed, including types of possible emergencies, capabilities and locations of emergency responders, and time required for responders to reach the incident location. Complete emergency management planning includes several additional factors, which are beyond the scope of this paper.

To address the preceding considerations, a matrix of responder capabilities to address different types of emergencies is proposed. Having every responder with the maximum capabilities for any possible incident is impractical both technically and economically. Conversely, not having a responder available that can adequately handle an incident can be costly

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in terms of lives and dollars. By establishing different capability levels for responders, any jurisdiction can effectively allocate its resources to meet the needs of its community. The same reasoning applies in assessing regional and national response coverage and needs.

The majority of emergency responders do not currently have advanced capabilities to handle hazardous materials incidents. However, these responders are often the first authority on the scene. It is important to distinguish, therefore, the different aspects of *first responder* versus *qualified responder* in the planning process. The first responder may not be prepared to enter the site of an incident but still must protect the surrounding population and area until a qualified responder can arrive to begin containment.

Although every incident has its own unique characteristics and special considerations, hazardous materials incidents can be grouped according to the type of response that would prove effective. This grouping allows the planner to establish the levels of response that must be available within an area and to identify the location of qualified responders.

Once the responders have been identified and their capabilities established, this information can be used to determine response coverage to potential incident sites. For a large area with multiple responders, performing this task manually would be extremely cumbersome, if not impossible. The distance from every responder to every accessible point in the area would have to be measured or calculated and the minimum response times determined. The use of a geographic information system to determine the precise locations of response units and transport facilities and the application of network routing algorithms make this a much more manageable task. The travel time to each point along the road network is then easily measured from the closest first and qualified responders to any location.

Using this approach in the planning process can help reduce the likelihood and severity of consequences. In the discussion to follow, a methodology for assessing emergency response capability according to this logic is presented.

EMERGENCY RESPONSE EVALUATION

Currently, most emergency responders in the public sector are fire departments. This is particularly true for first responders. These range from small, rural volunteer units to paid urban, multistation professional units. Similarly, a variety of hazardous commodities are stored or travel through the areas served by these departments.

To develop an understanding of the significance of this relationship, five response capability levels were defined, corresponding to the material involved and level of expertise required to constitute a qualified response. This multitiered approach provides several advantages. Local responders and elected officials can determine the level of preparedness they choose to have on the basis of local characteristics. This approach also allows jurisdictions to develop a cost-effective means for reaching funding and training goals. At the same time, this system provides a measurement for defining the specific types of materials and incidents to which a team is qualified to respond. Within this framework, it becomes apparent when a potential incident would be beyond a team's capability, resulting in the need to request or locate a more advanced team.

Team Levels

Whereas no national standards for response teams currently exist, the five capability levels were developed on the basis of existing training and equipment standards for entry levels as defined by the National Fire Protection Association (NFPA) (*1*).

As requirements for each level were established, they were reviewed with the Tennessee Emergency Management Agency (TEMA) to ensure validity. The requirements, as they currently exist, are being used by TEMA to evaluate Tennessee's emergency response capabilities (*2*).

Level 5 is the lowest capability rating. Fire departments with this level have the ability to do only minimal assessment, work in nonhazardous areas, and Level D entry as defined by the NFPA. Although this level does not require the formation of a hazardous materials team, members of the department must have basic training in hazardous materials awareness. By current legislation, every fire department in the country should be at this level.

Level 4 teams are able to handle explosives and flammables and could perform related assessment and containment. This level does not include any chemical protection. Approximately 50 percent of all hazardous materials incidents require this response capability.

The capability to respond to chemical incidents begins with Level 3. Primarily corrosives and peroxides are handled by this level, which corresponds to the NFPA Level C entry classification and is appropriate for an estimated 75 percent of hazardous materials responses.

Level 2 teams can respond to poisonous and etiologic materials and have capabilities that correspond to the NFPA Level B entry classification. This level includes specialized training and more extensive air supplies than Level 3. Approximately 85 percent of incidents can be handled by teams at this level.

A unit with a Level 1 rating (the most qualified response team) has the greatest chemical protection, Level A by NFPA definition, and can respond to incidents involving poison gases.

These classifications are progressive, meaning that a Level 2 team can respond to Level 3, 4, and 5 incidents, and so forth.

Team Capability Evaluation

To evaluate a hazardous materials response team, four important components of overall response capability were identified: adequate numbers of trained personnel, proper equipment, medical surveillance, and proper site planning and documentation. The specific requirements for each team level based on these four areas are given in Table 1. From these requirements, a detailed survey shown in Figure 1 was developed to serve as a basis for rating fire departments and other agencies that are primary responders to an incident.

Information from this survey is linked directly to the qualifications given in Table 1. For example, the personnel and

TABLE 1 Hazardous Materials Response Team Capability Criteria

Level 5 Capability - (Minimum for all fire departments)

Personnel:	Senior Officer -	First Responder Operations Level Incident Command Training
	HM Team Leader -	Not applicable
	Team Members -	Not applicable
	Support -	First Responder Awareness Level Thoroughly familiar with assigned PPE
Equipment:	Binoculars DOT HM Response Guidebook Radio Communications	
PPE:	SCBA SFPC	
Planning:	Approved & Exercised Title III Plan	
Medical:	Not applicable	

Level 4 Team

Personnel:	Senior Officer -	First Responder Operations Level Incident Command Training
	HM Team Leader -	Technician Level Incident Command Training
	Team Members -	4 Members First Responder Operations Level
	Support -	First Responder Awareness Thoroughly familiar with assigned PPE and procedures
Equipment:	Binoculars DOT HM Response Guidebook Radio Communications Two flammable gas detectors Fire fighting foam Equipment to extinguish spill, fires and suppress flammable vapors At least 4 reference books in portable library Dyking materials CDV-777-1 Radiological Monitoring Kit	
PPE:	SCBA SFPC	
Planning:	Approved & Exercised Title III Plan	
Medical:	Team Members meet OSHA physical requirements	

Level 3 Team

Personnel:	Senior Officer -	Technician Level Incident Command Training
	Team Leader -	Specialist Level Incident Command Training
	Team Members-	4 Members Technician Level
	Support -	First Responder Operations Thoroughly familiar with assigned PPE and procedures
Equipment:	Binoculars DOT HM Response Guidebook Radio Communications Two flammable gas detectors Fire fighting foam Equipment to extinguish spill, fires and suppress flammable vapors At least 6 reference books in portable library Dyking materials Decontamination equipment pH paper Simple plugging supplies Highway hazard Radiological Kit	
PPE:	Level C	
Planning:	Approved & Exercised Title III Plan	
Medical:	Team Members	

(continued on next page)

TABLE 1 *(continued)*

Level 2 Team			
Personnel:	Senior Officer -		Technician Incident Command Training
	Team Leader -		Specialist Level Incident Command Training Additional specialized training
	Team Members-		4 members Technician Level At least 2 with Specialist Level
	Support -		Technician Level
	Dept. Adm Officer		Technician Level
Equipment:	Binoculars DOT HM Response Guidebook Radio Communications Two flammable gas detectors Fire fighting foam Equipment to extinguish spill, fires and suppress flammable vapors At least 6 reference books in portable library Dyking materials Decontamination equipment pH paper Simple plugging supplies Highway hazard Radiological Kit		
PPE:	Level B 1 hour rated SCBA On or near-sight SCBA refill capability		
Planning:	Approved & Exercised Title III Plan		
Medical:	Team Members meet OSHA physical requirements		
Level 1 Team			
Personnel:	Senior Officer -		Technician Level Incident Command Training
	Team Leader -	At least	2 leaders Specialist Level Incident Command Training Rad Inst III Additional specialized training
	Team Members-		4 members Technician Level At least 3 with Specialist Level
	Support -		Technician Level
Equipment:	Binoculars DOT HM Response Guidebook Radio Communications Two flammable gas detectors Fire fighting foam Equipment to extinguish spill, fires and suppress flammable vapors At least 6 reference books in portable library Dyking materials Decontamination equipment pH paper Simple plugging supplies Highway hazard Radiological Kit		
PPE:	Level A 1 hour rated SCBA On or near-sight SCBA refill capability Flame resistant coveralls		
Planning:	Approved & Exercised Title III Plan		
Medical:	Team Members meet OSHA physical requirements		

County:	**HAZARDOUS MATERIALS EMERGENCY RESPONSE SURVEY**	EM USE ONLY
City:		Team Level:
Region:		Date:
Date:		Rated By:

Instructions: (1) Please type or print clearly. (2) Complete a separate form for each station/substation with HazMat response capability. (Make additional copies as needed.) (3) Return completed surveys to:

1. General Information

Department/Agency: 1________ Team Leader: 2________

Mailing Address: 3________ Business Phone: 4( )________

City: 5________ State: 6________ Zip: 7________ Emergency Phone: 8( )________ (Other than 911)

FAX Number: 9( )________

Station Location (Street Address): 10________

Location (if known) Latitude: 11________ Longitude: 12________

No. Paid: 13________ No. Volunteer: 14________ No. Assigned to Team: 15________ Avg. Response Time: 16________

2. Jurisdictional Profile *(please include a map indicating boundaries and response stations)*

Total Population Served: 17________ Area (square miles): 18________

Major Highways: 19________ Major Railroads: 20________

Navigable Rivers: 21________ Airports: 22________

Multi-jurisdictional Response? 23___Yes___No Industrial Mutual Aid Agreement? 24___Yes___No

List Jurisdictional(s) served by written mutual aid agreements:

25________

Comments:

26________

3. Capabilities Assessment

Planning: Has the jurisdiction completed SARA Title III Emergency Management Plan? 27___Yes___No

Has the plan been successfully exercised and evaluated? 28___Yes___No

Date of last exercise: 29________

Medical Surveillance: Are team members participating in a medical surveillance program in accordance with OSHA 1910.120? 30___Yes___No

FIGURE 1 Hazardous materials emergency response survey. ***(continued on next page)***

training for a Level 3 team would require the following entries in the survey:

- Boxes 33 and 34 would each require at least 1 for the senior officer,
- Boxes 39 and 41 would each require at least 1 for the team leader,
- Box 46 would require at least 4 for the team members, and
- Box 50 would require at least 1 for the support staff.

Additional requirements follow similar logic to define the capability of a team from the results of the survey.

The guidelines for site planning and documentation required for hazardous materials teams are specified in SARA Title III legislation. Similarly, the medical surveillance program is defined by Occupational Safety and Health Administration regulations in 29 CFR 1910.120. The training specifications follow the requirements defined by NFPA (*3*). The required number of personnel and level of training for each team level were established on the basis of experience and guidance provided by several government and state agencies. Necessary equipment, which includes personal protection equipment (PPE in Table 1), was also established from experience and guidance from NFPA (*4*) and the Environmental Protection Agency (EPA) (*5*).

4. Training: *(List the total number of personnel currently trained to the levels listed below. Do not include anyone who has not received initial and/or refresher training in the past two years)*

	Awareness	Operations	ICS	Technician	Specialist	Advanced
Senior Officer: Check if Team Leader ___	31	32	33	34	35	36
Team Leader(s)	37	38	39	40	41	42
Team Members	43	44	45	46	47	48
Support Personnel	49	50	51	52	53	54
Totals	55	56	57	58	59	60

5. Equipment: *(List number of pieces in the appropriate blanks)*

PPE	Detectors	Respirators	Containment
Turnouts (SFPC) 61___	Combustible Gas 71___	30 min SCBA 81___	Booms/Pads 91___
Level C 62___	Oxygen Level 72___	60 min SCBA 82___	Plugs/Patches 92___
Level B 63___	Detector Tubes 73___	Air Line 83___	Plastic 93___
Level A 64___	Photoionization 74___	1/2 Mask Cartridge 84___	Shovels 94___
Fire Res Coveralls 65___	Flame Ionization 75___	Full Mask Cartridge 85___	Absorbants 95___
Proximity Suit 66___	Organic Vapor 76___	86___	Recovery Drums 96___
Disposable Suits 67___	CDV-777-1 Kit 77___	87___	Solidifiers 97___
Cooling Vests 68___	Rad Hwy Haz Kit 78___	88___	Neutralizers 98___
69___	Strips 79___	89___	99___
70___	pH Paper 80___	90___	100___

Non-Sparking Tools? 101___Yes___No SCBA Refill: Cascade: 111_____Fixed 112_____Portable

Decontamination? 102___Yes___No Compressor: 113_____Fixed 114_____Portable

No. Reference Books? 103______ Foam (enter no. of gal): Alcohol: 115_____Protein: 116_____

DOT P 5800.5 1990 ERG 104___Yes___No Light water: 117_____ Other: 118_____

List Additional 105________________ 108________________

106________________ 109________________

107________________ 110________________

6. Communications/Information Management

Cellular Phone 119___Phone Number(s) 120________________

Radio: 121___Bands(s)/Frequency(s) 122________________

FAX: 123___Fixed: Phone Number 124________________ 125___Portable: Phone Number 126________________

Computer: 127___Fixed 128_____IBM compatible 129_____Apple/Mac

130___Portable 131_____IBM compatible 132_____Apple/Mac

Programs: 133___Cameo 134___Archie 135___Plume Modeling 136___EIS 137________________Others

7. Survey Completed by:

Print Name ________ Title/Rank ________ Signature ________

Date:________________ Phone Number:(_____)________________

FIGURE 1 *(continued)*

In addition to the information required to evaluate a response team, the survey includes three other sections where relevant information is gathered: team identification and location, jurisdictional profile, and communications and information management capabilities.

By using this approach to evaluate response capability, two purposes are realized. First, the current capability level of the response unit is identified. Second, and just as important, the necessary improvements for a team to move from one level to the next higher level can be determined.

HAZARDOUS MATERIALS RANKING

Because of the diversity of hazardous materials that are manufactured or transported, the qualifications necessary to respond to incidents involving each type of material must be understood. For the most part, materials that have similar characteristics behave comparably. Therefore, at the screening level it is appropriate to consider general classes of materials for emergency response rather than each of the thousands of chemicals and chemical compounds independently.

Various organizations have established or defined classes or lists of hazardous materials for regulatory or rapid identification purposes. These include the U.S. Department of Transportation (DOT), the International Maritime Organization (IMO), EPA, and NFPA. Recently, DOT redefined its classifications to closely match the IMO system, which is used by other countries. The DOT *Emergency Response Guidebook* uses this classification system (*6*).

Because emergency response teams must handle incidents for transported material as well as for fixed facilities, the DOT hazard classification scheme was adopted to provide the initial link between response capabilities and hazardous material type. As more detailed planning is performed, additional criteria may be incorporated, such as container type and size.

Most materials within the same hazard class require the same level of response, and once that level has been identified, the appropriate responder can be determined. Table 2 gives these classes with the corresponding minimum team level as defined previously.

RESPONSE TIMES

To complete the evaluation of emergency response coverage, the location of response units and their qualifications are interfaced with the transportation network. Information technologies such as geographic information systems combined with network algorithms can facilitate determination of the time required for any responder to reach any point in the network.

This analytical environment provides the ability to perform several planning tasks. The first is to determine the expected response time to an incident location. Another application is the identification of geographic areas of inadequate response

TABLE 2 Emergency Response Requirements by Hazardous Materials Class

CLASS		TEAM LEVEL
Class 1	Explosives	
1.1	Explosives with a mass explosion hazard	4
1.2	Explosives with a projection hazard	4
1.3	Explosives with predominantly fire hazard	4
1.4	Explosives with no significant blast hazard	4
1.5	Very insensitive explosives	4
1.6	Extremely insensitive explosive articles	4
Class 2	Gases	
2.1	Flammable gases	4
2.2	Nonflammable gases	4
2.3	Poison gases (Class A Poisons)	1
2.4	Corrosive gases (Canadian)	4
	Chlorine (old designation)	2
Class 3	Flammable liquids	
3.1	Flashpoint below -18C	4
3.2	Flashpoint between -18C and 23C	4
3.3	Flashpoint between 23C and 61C	4
	Fuel Oil (old designation)	4
Class 4	Flammable solids; Spontaneously combustible materials; and materials that are dangerous when wet	
4.1	Flammable solids	4
4.2	Spontaneously combustible material	4
4.3	Materials that are dangerous when wet	2
Class 5	Oxidizers and Organic peroxides	
5.1	Oxidizers	4
5.2	Organic peroxides	3
	Oxygen	4
Class 6	Poisonous and Etiologic (infectious) materials	
6.1	Poisonous materials (Class B Poisons)	2
6.2	Etiologic (infectious) materials	2
Class 7	Radioactive materials	4
Class 8	Corrosives	3
Class 9	Miscellaneous hazardous materials	4 until identified
	ORM D	4 until identified

coverage for a specific hazardous materials shipment or fixed facility. Finally, this information can be used to allow individual emergency response units and the organizations that manage them to examine their current capability and identify the additional personnel, training, and equipment necessary to advance to a higher level of response capability, if deemed appropriate. This analysis environment can be easily extended to assess the value of establishing regional response teams that might have greater capabilities than local teams. The regional team would cover a larger area, and the necessary resources required to operate the team would be distributed over several jurisdictions.

CASE STUDY

To illustrate the use of this methodology in practice, these techniques were applied in performing an emergency response capability assessment for a selected county in southern Texas.

County Response Capabilities

The county currently has three fire departments that could respond to a potential hazardous materials incident. Each department was contacted and requested to fill out a capabilities survey. On the basis of the completed response, each department was assigned a capability rating as summarized in Table 3. The necessary requirements for each department to improve to the next capability rating are also included in Table 3.

Fire Department 1 is currently the most qualified response team in the county and has a Level 3 rating. This team requires only additional training to move from Level 3 to Level 2. Improving to Level 1 would require adding a second team leader and obtaining fire resistant coveralls for the team.

Fire Department 2 currently does not qualify for a Level 5 rating. By developing an emergency response plan and providing department members with minimal hazardous materials training, the department would be able to achieve a Level 5 capability.

Although Fire Department 3 was also assigned a Level 3 capability rating, the department would require additional training and upgrading of the self-contained breathing apparatus from 30- to 60-min capacities to reach Level 2. An increase to Level 1 capability would require adding equipment, upgrading personal protection equipment, and adding training.

Establishing Required Response Capability

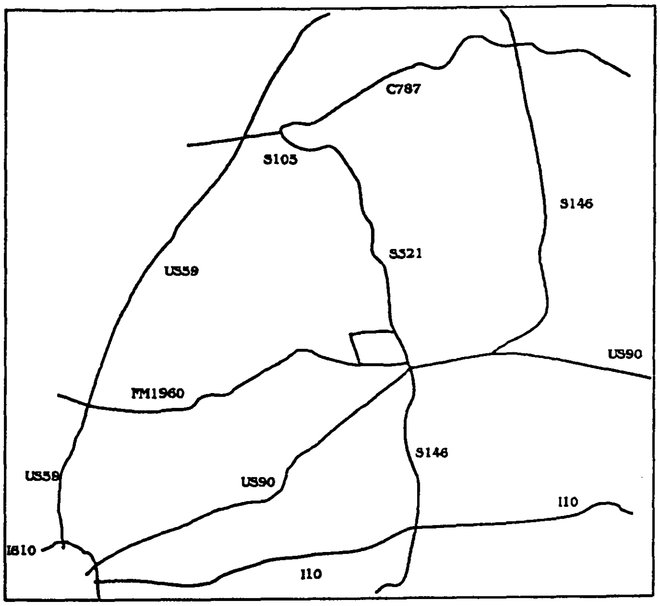
A commodity flow study carried out at the proposed site enumerated the types of hazardous materials that pass through the county. From Table 2, materials within Classes 1.4, 1.5, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, and 5.2 were identified as the materials involved. On the basis of the corresponding minimum response team capability needed among these groups, Class 4.3, materials that are dangerous when wet, requires the highest level of response capability at Level 2. Consequently, qualified response can only be met by units with capabilities of Level 2 or Level 1. At a minimum, therefore, having at least one Level 2 team within the county is necessary.

Measuring Response Coverage

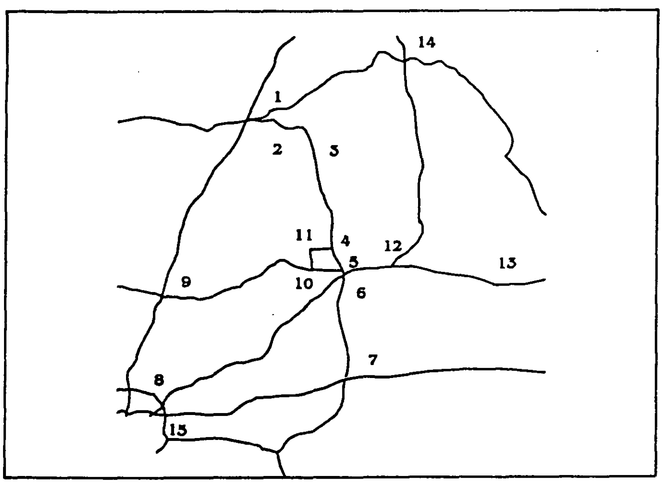
Using network optimization algorithms designed to determine minimum travel times from any point in the county to all other points, minimum response times to various highway locations in the county were computed. Figure 2a shows a map of the major highways in the county. Figure 2b shows the same map with highway names removed and the addition of a unique number assigned to each major junction. In Figure

TABLE 3 Summary of Case Study Responder Capabilities

Fire Dept	Capability Rating	Required Improvements to Reach Next Level	
1	Level 3	To acquire Level 2:	2 Team Members with Specialist Training
			Support Personnel with Technician Training
2	Not rated	To acquire Level 5:	Jurisdiction acquire HM Response Plan
			Senior Officer with First Responder Operations Training and Incident Command Training
			Support Personnel with First Responder Awareness Training
3	Level 3	To acquire Level 2:	Senior Officer with advanced training
			2 team members with Specialist Training
			Support Personnel with Technician Training
			PPE must upgrade to 60-min SCBA's



(a)



(b)

FIGURE 2 County road network: (*a*) major highways, (*b*) numbered junctions.

2b, the locations of Fire Departments 1, 2, and 3 correspond to Intersection Points 1, 6, and 12, respectively.

The map in Figure 2b was used as the basis for determining the most rapid response time from each responder to each point in the county. Table 4 gives a summary of calculated response times, presented as a matrix by response team and highway location.

The results of this analysis can be used to illustrate the array of options available to the county. Initially, if the hazardous material ranked under Class 4.3 from Table 2 did not pass through the county, emergency response coverage would be adequate and no improvements would be required. Because of the existence of this material, at least one of the fire departments should be upgraded to Level 2 capabilities. From

TABLE 4 Response Times Within the Texas County

Junction Number (Figure 2)	Response Times (min)		
	Fire Dept 1	Fire Dept 2	Fire Dept 3
1	0	39.74	46.61
2	1.39	38.35	45.22
3	7.94	31.80	38.67
4	31.50	8.24	15.11
5	38.49	1.25	8.12
6	39.74	0	6.87
7	62.06	22.32	29.19
8	54.62	36.25	43.12
9	31.87	48.08	54.95
10	48.92	12.86	19.73
11	40.21	16.95	23.82
12	46.61	6.87	0
13	81.61	41.87	35.00
14	44.93	47.47	40.60

Table 3, Fire Department 1 be the least expensive to upgrade. However, if a response time of more than 60 min is considered unacceptable, this department has two areas with excessive response times (from Table 4). This might indicate that the extra expense to upgrade Fire Station 3 should be incurred. If the acceptable response time were established as 45 min, Fire Departments 1 and 3 would both require upgrading to Level 2 capability. Collectively they could then respond within this window to any potential hazardous materials incident that might occur in the study region.

EXTENDED APPLICATIONS

Although the discussion presented centers on emergency response planning for hazardous materials, this approach can be extended to regional- and national-level planning, real-time incident management, and applications involving earthquakes, floods, fires, and other emergencies.

Regional and National Planning

The process discussed in this paper is directly applicable to broader planning processes. Extending this to regional and national plans is straightforward. The approach to evaluating responder qualifications and material classifications remains unchanged. Response times would be adjusted to reflect the level under consideration.

By establishing a uniform procedure for hazardous materials incident planning, such as the one presented, the planning process becomes consistent and easily adaptable to any planning level.

Incident Management

With the appropriate communications links, this emergency response planning methodology can be extended to encompass incident management. When an incident is reported, the location and material involved would be used to identify and contact the nearest qualified responder. The time for that responder to arrive at the scene could be reported to the acting incident commander, giving that person critical information on which to base decisions concerning immediate actions that should be taken.

This information could also provide input into an overall emergency management package that included evacuation and rerouting capabilities. The location of sensitive areas could be provided to the incident commander to allow that person to make informed decisions about personnel and equipment deployment, cordoning, containment, and evacuation, if required.

Other Emergencies

Although response to hazardous materials emergencies has received much attention in the form of legislation and public concern, other emergencies that often affect significantly larger populations and geographic areas occur frequently, albeit randomly. Forest fires, floods, earthquakes, and other natural disasters require varying levels of emergency response that could be evaluated by extending this methodology. In a similar manner, this methodology could be applied to police work. Special teams, such as SWAT teams, have different levels of qualifications for different situations.

In these instances, the definition of capability ratings and location of qualified teams will vary, but the approach is identical to the one used for hazardous materials emergency response. Overlaying this information on a spatial platform adds a new dimension to incident management and planning that has previously been unavailable.

CONCLUSIONS

Effective emergency response in the event of a hazardous materials incident can be literally a matter of life or death. The best way to ensure an effective response is through adequate planning and preparation. Planning requires information about the responders, the possible incidents, and the time involved. Preparation requires having qualified responders available.

The approach presented herein provides a systematic procedure for achieving this goal. The response capabilities within a planning area can be uniformly evaluated. As finances become available, response teams can be upgraded using a logical and consistent rationale.

This methodology is extremely flexible and can be used in a variety of applications. It can be applied at the local, regional, or national level for single jurisdictions or multiple-planning areas. Whether a potential incident occurs at a fixed facility or while in transport, the methodology is equally valid.

Effective emergency response coverage for natural and man-made disasters is essential to the well-being of our population and the environment. A consistent, flexible approach, such as the one presented here, can facilitate this goal.

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