Mitigation Case Studies

Hardened First Responder Facility

911 Communication and Emergency Operations Center
Smith County, Texas

September 2003

FEMA

"We were amazed at how many EOCs had structures that are not designed to resist any extreme loading event. We wanted to make sure our EOC could handle tornadoes."

— Jim Carlyle, Chairman of the Smith County Research and Planning Committee

SOURCE: EUBANKS & HARRIS ARCHITECTS, INC

Case Studies

SMITH COUNTY, TEXAS

Smith County is located in east Texas, approximately 100 miles east of Dallas. It is largely rural, with only one metropolitan area, the City of Tyler. The Sheriff of Smith County and the Police Chief of the City of Tyler saw a need for a consolidated emergency operations and communications center that would serve the entire Smith County population. From past experience, they believed that this consolidation would reduce fragmentation and duplication of emergency services, and allow services to be provided in a more efficient and cost-effective manner.

EUBANKS & HARRIS ARCHITECTS, INC.

Computer rendering of the Smith County 911 Communications Dispatch and Emergency Operations Center.

The county has begun construction of a state-of-the-art facility that will serve as the centralized 911 communications dispatch and emergency operations center (EOC) for approximately 30 agencies (serving a population of approximately 175,000). Notable features of this 15,000-square-foot facility include a roof and exterior walls hardened to resist tornadic forces, a lobby designed to minimize blast effects, multiple security access levels, and an area specifically planned for press conferences, interviews, and other interaction with members of the media.

Ground clearing and construction of the Smith County 911 Communications Dispatch and Emergency Operations Center began in mid-October 2002.

Case Studies

SMITH COUNTY, TEXAS

Defining Essential Functions

In addition to its main role of providing 911 dispatch functions, the Smith County facility will serve as the EOC during times of disaster. It will be the primary coordination and control point for all counter-disaster efforts. Before designing this facility, Smith County defined seven essential functions that take place at an EOC before, during, and after a disaster:

EUBANKS & HARRIS ARCHITECTS, INC.

Computer renderings of the Smith County 911 Communications Dispatch and Emergency Operations Center.

Coordination. The EOC serves as the coordination point for the activities of emergency responder organizations (e.g., police, fire, and ambulance; American Red Cross; Salvation Army; and Federal, state, and local agencies), providing a centralized meeting, planning, and reporting facility.

Policy-making. Policies and procedures are often developed at an EOC in anticipation of disaster events. Ideally, these policies and procedures will ensure that the EOC and emergency response activities run as smoothly as possible.

Operations Management. The EOC serves as the central point for managing the deployment of personnel and resources for disaster mitigation, preparedness, response, and recovery in the field. Because the situation during a disaster is continuously changing, the staffing and resources must be able to keep up with these changes.

Information Management. Information pours into the EOC during a disaster. Data concerning the execution of disaster response, damage assessments, and recovery operations must be collected, analyzed, and distributed to the appropriate parties so that it can be acted on in an effective and timely manner.

Documentation. Information gathered at the EOC during a disaster becomes a vital tool in decision-making, both during and after times of emergency response. For example, documentation of damage levels can be used in GIS-based analyses that enable emergency workers to assess the effects of the disaster and compare them to the effects of other events. Furthermore, documentation of emergency response methods during a disaster event allows for future evaluation of what worked and what did not work. This information is often used to define "lessons learned," which can help guide the development of future policies and procedures.

Public Information. The EOC is responsible for disseminating information about mitigation, preparedness, response, and recovery to the general public, the public at risk, and the media.

Hosting Visitors. Local and regional officials are ultimately responsible for the protection of citizens and public resources during disaster events. These officials, and others such as the President, may visit the site after a large disaster, and the EOC staff must be prepared to escort them through the EOC and designate an area where the visitors are permitted to observe the operations.

Evaluating Existing EOC Designs

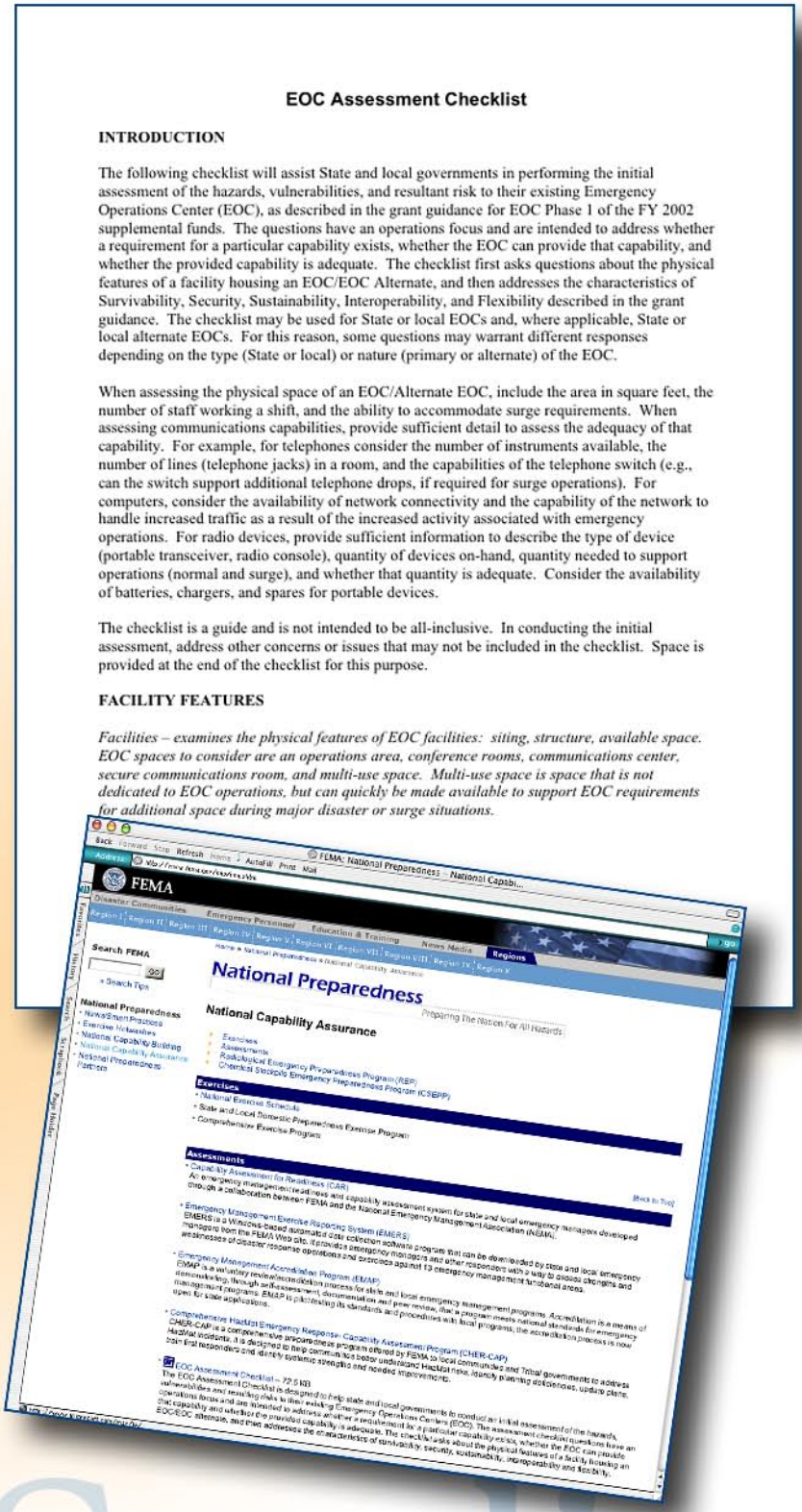
After the essential EOC functions were defined, a Research and Planning Committee was created to visit communities with EOCs whose sizes and scopes of service were similar to those planned by Smith County. The purpose was to learn how the design and amenities of those facilities influence their operations. Committee members visited EOCs across the Nation and recorded features they liked and disliked at each site. The visits provided valuable information for Smith County, including elements the county wanted to incorporate into its new facility, as well as obstacles to be avoided.

EOC Assessment Checklist

FEMA has developed an EOC Assessment Checklist to help state and local governments assess hazards that can affect an EOC and its vulnerabilities to those hazards. Architects and engineers will find this checklist useful in defining key features of the architectural, building system, and structural design of an EOC. The checklist is divided into six sections:

1. **Facility Features –** examines the physical features of the EOC
2. **Survivability –** examines the ability of the EOC to sustain the effects of a hazard event and continue operations after the event has occurred
3. **Security –** examines the protection of the EOC facility, its occupants, and communications equipment and systems from relevant hazards
4. **Sustainability –** examines the ability of the EOC to operate for extended periods of time without interruption
5. **Interoperability –** examines the extent to which the EOC shares common principles of operations and information exchange with local, state, and Federal jurisdictions
6. **Flexibility –** examines the ability of the EOC to adapt the scale and pace of its operations to the demands of specific hazard events

The EOC Assessment Checklist can be downloaded at http://www.fema.gov/onp/nca.shtm.



EOC Assessment Checklist

INTRODUCTION

The following checklist will assist State and local governments in performing the initial assessment of the hazards, vulnerabilities, and resultant risk to their existing Emergency Operations Center (EOC), as described in the grant guidance for EOC Phase 1 of the FY 2002 supplemental funds. The questions have an operations focus and are intended to address whether a requirement for a particular capability exists, whether the EOC can provide that capability, and whether the provided capability is adequate. The checklist first asks questions about the physical features of a facility housing an EOC/EOC Alternate, and then addresses the characteristics of Survivability, Security, Sustainability, Interoperability, and Flexibility described in the grant guidance. The checklist may be used for State or local EOCs and, where applicable, State or local alternate EOCs. For this reason, some questions may warrant different responses depending on the type (State or local) or nature (primary or alternate) of the EOC.

When assessing the physical space of an EOC/Alternate EOC, include the area in square feet, the number of staff working a shift, and the ability to accommodate surge requirements. When assessing communications capabilities, provide sufficient detail to assess the adequacy of that capability. For example, for telephones consider the number of instruments available, the number of lines (telephone jacks) in a room, and the capabilities of the telephone switch (e.g., can the switch support additional telephone drops, if required for surge operations). For computers, consider the availability of network connectivity and the capability of the network to handle increased traffic as a result of the increased activity associated with emergency operations. For radio devices, provide sufficient information to describe the type of device (portable transceiver, radio console), quantity of devices on-hand, quantity needed to support operations (normal and surge), and whether that quantity is adequate. Consider the availability of batteries, chargers, and spares for portable devices.

The checklist is a guide and is not intended to be all-inclusive. In conducting the initial assessment, address other concerns or issues that may not be included in the checklist. Space is provided at the end of the checklist for this purpose.

FACILITY FEATURES

Facilities – examines the physical features of EOC facilities: siting, structure, available space. EOC spaces to consider are an operations area, conference rooms, communications center, secure communications room, and multi-use space. Multi-use space is space that is not dedicated to EOC operations, but can quickly be made available to support EOC requirements for additional space during major disaster or surge situations.

Site Considerations

One of the first steps in the successful design of an EOC is selecting an appropriate site. A prime consideration in site selection is that an EOC must remain operational during and after a disaster in order to perform its vital functions. Consequently, site selection depends largely on the identification of potential hazards that could impact the EOC and the surrounding communities. An EOC should be placed where these identified potential hazards will have the least impact on its operation, but where a timely response can still be made by emergency personnel.

Natural Hazards

Natural hazards tend to be related to geographic regions – tornadoes in the Midwest, hurricanes and high winds in coastal areas, earthquakes in the West and Southeast, and heavy

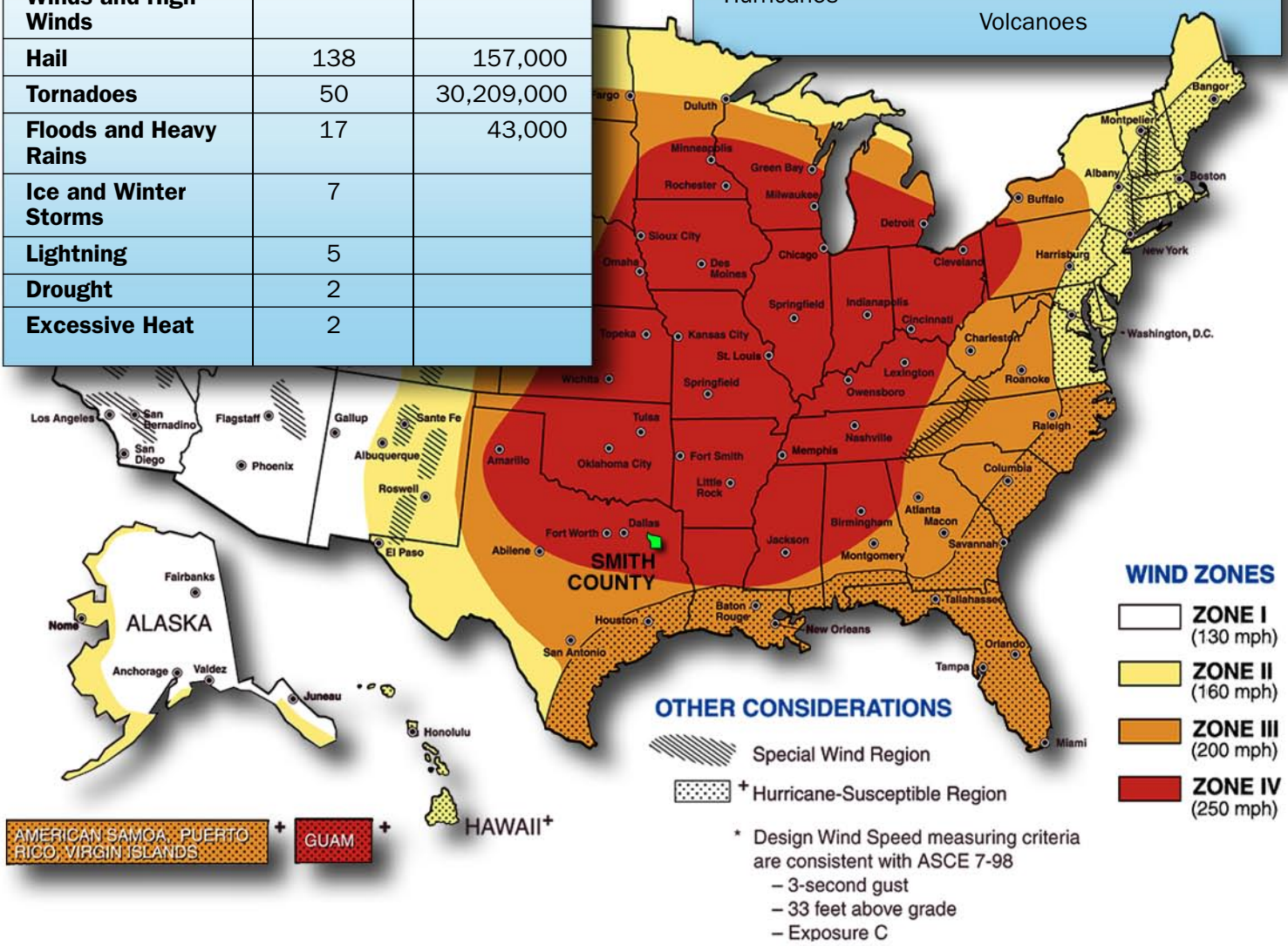
Potential Natural Hazards

- Drought
- Earthquakes
- Excessive Heat
- Fires
- Floods and Heavy Rains
- Hail
- Hurricanes
- Ice and Winter Storms
- Landslides
- Lightning
- Thunderstorm Winds and High Winds
- Tornadoes
- Tsunamis
- Volcanoes

Natural Hazards in Smith County (1950-2002)

Hazard	Number of Incidents	Damage in Dollars
Thunderstorm Winds and High Winds	147	945,000
Hail	138	157,000
Tornadoes	50	30,209,000
Floods and Heavy Rains	17	43,000
Ice and Winter Storms	7	
Lightning	5	
Drought	2	
Excessive Heat	2	

DATA SOURCE: NOAA



winter storms in northern states. When EOCs are built in these areas, such hazards are usually unavoidable and must be taken into consideration in the physical design of the facility. Other regional hazards, however, such as flooding and landslides, are more easily avoided. For example, an EOC can be located outside the 500-year floodplain or on stable soils.

Smith County is in an area considered to be at high risk for severe tornadoes. In the past 52 years, the most frequently occurring natural hazard for the county has been high winds. Smith County has experienced approximately 200 high-wind incidents that have resulted in over 30 million dollars in damage.

Technological Hazards

The assessment of technological and human-generated hazards involves the investigation of surrounding facilities, infrastructure, and land use. Hazards include the following:

- industrial, manufacturing, or commercial facilities with the potential for industrial accidents or acts of malice
- potential terrorist targets
- hazardous materials storage facilities and transportation routes
- areas susceptible to inundation as a result of the failure of dams and levees

Sites in areas that encompass such identified potential hazards are, therefore, inappropriate locations for EOCs.

Potential Technological Hazards

Fires

Floods (from dam and levee failures)

Hazardous materials releases

Nuclear accidents

Terrorism

- Agriterrorism
- Armed attack
- Arson/incendiary attack
- Attack with biological, chemical, or radiological agent
- Conventional bombing
- Cyberterrorism
- Hazardous materials release
- Nuclear bombing

Potential Terrorist Targets

The U.S. Code of Federal Regulations defines terrorism as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." Potential terrorist targets can be difficult to identify, but, in general, terrorists want media high-exposure and attention. They achieve this by targeting areas or facilities where damage will result in: (1) a potentially high number of casualties, (2) extensive media coverage, and (3) a disruption of everyday life. Potential targets include the following:

Emergency Support Facilities
- Fire stations
- Police stations

Financial Facilities
- Banks
- Credit card companies

Government Facilities
- Courthouses
- Federal/state/local offices
- Post offices

Health Care Facilities
- Clinics
- Hospitals

Industrial Facilities
- Chemical manufacturers

Military Facilities
- Academies
- Armories
- Bases

Political Icons
- Political party offices
- Political rallies

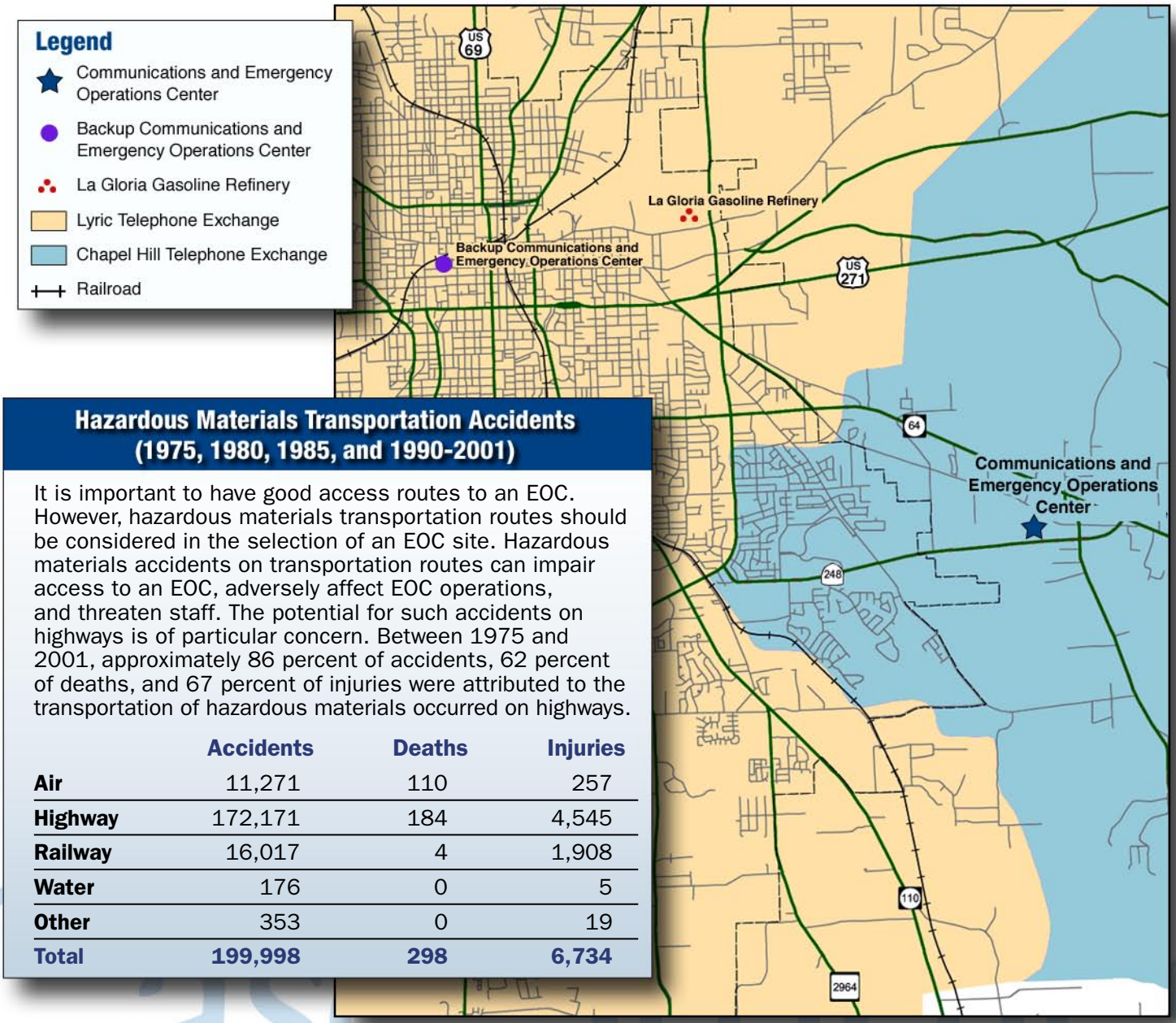
Research Facilities
- Animal testing facilities
- Stem cell research facilities

Tourist Attractions
- Concerts and theaters
- Festivals
- Landmarks
- Sporting facilities
- Theme parks

Utilities
- Communications
- Electricity (nuclear, hydroelectric)
- Gas
- Water supply

Smith County identified three major technological hazard siting considerations for its communications and emergency operations center:

1. The new facility had to be located in a different telephone exchange from the backup communications and emergency operations center so that the loss of telephone service in one exchange would not affect both facilities.
2. The La Gloria Gasoline Refinery (located within the city of Tyler) presents a major potential hazard for industrial accidents or acts of malice, so a site was chosen away from the refinery.
3. Two railways and two U.S. highways run through Smith County. Locating the EOC near any of these major transportation routes was avoided because they all may carry potentially hazardous cargo.



Hazardous Materials Transportation Accidents (1975, 1980, 1985, and 1990-2001)

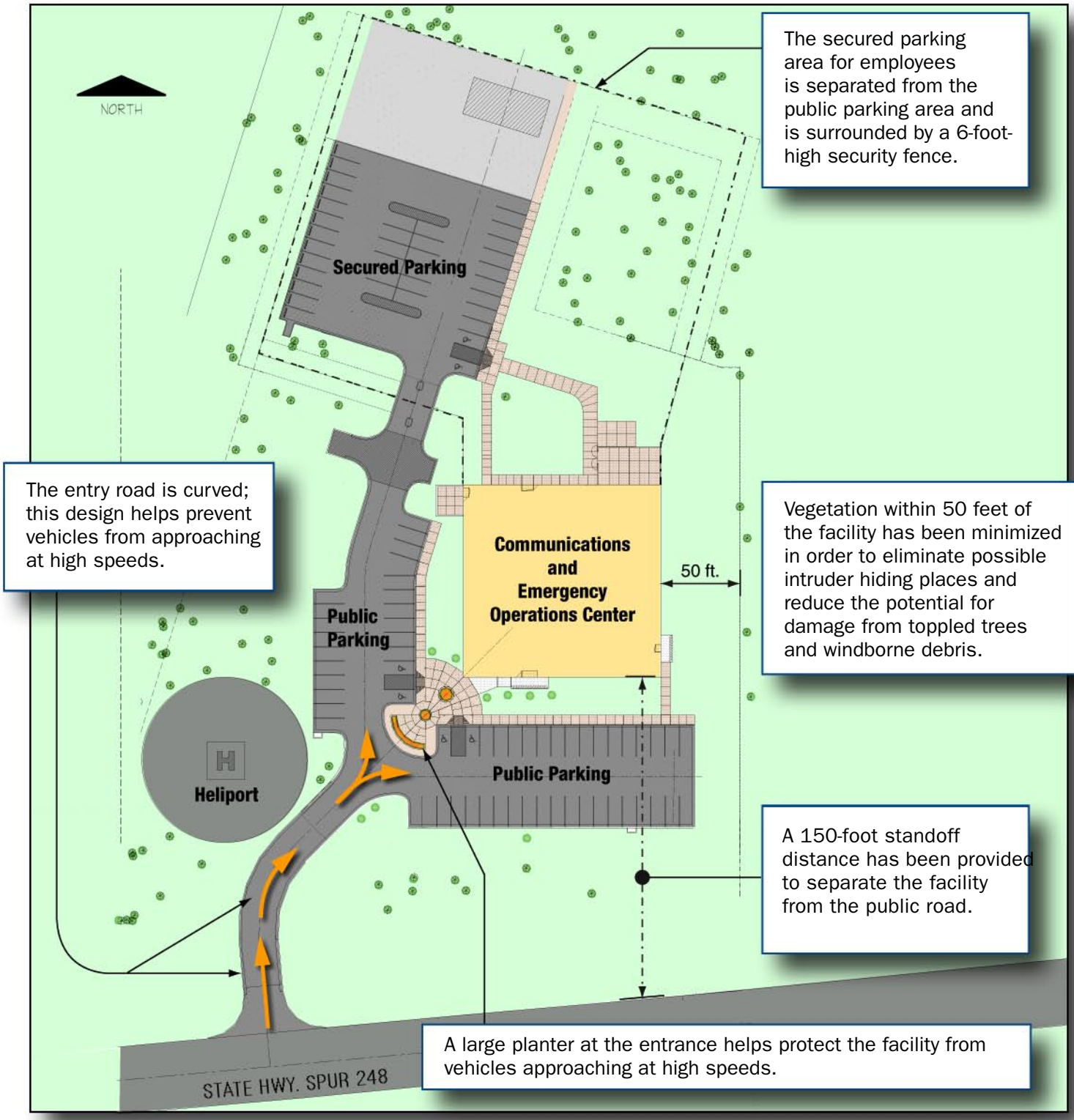
It is important to have good access routes to an EOC. However, hazardous materials transportation routes should be considered in the selection of an EOC site. Hazardous materials accidents on transportation routes can impair access to an EOC, adversely affect EOC operations, and threaten staff. The potential for such accidents on highways is of particular concern. Between 1975 and 2001, approximately 86 percent of accidents, 62 percent of deaths, and 67 percent of injuries were attributed to the transportation of hazardous materials occurred on highways.

	Accidents	Deaths	Injuries
Air	11,271	110	257
Highway	172,171	184	4,545
Railway	16,017	4	1,908
Water	176	0	5
Other	353	0	19
Total	**199,998**	**298**	**6,734**

SOURCE DATA: http://www.bts.gov/publications/national_transportation_statistics/2002/
EXCEL FILE: http://www.bts.gov/publications/national_transportation_statistics/2002/excel/table_02_06.xls

Site Security Design

Once a site has been selected, the site design (e.g., building locations, access, parking, landscaping) must be developed. For an EOC, one of the main goals of site design is ensuring the security of the facility and its staff. Smith County addressed site security for its facility by providing secure parking, controlling vehicular access, locating buildings away from the site perimeter, and minimizing vegetative cover.



Hardened First Responder Facility

Structural Design

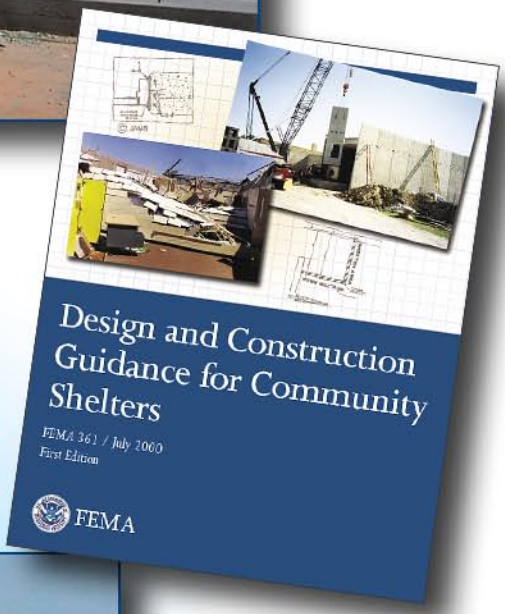
Because Smith County is in a region susceptible to severe tornadoes, the new communications and emergency operations center, including its utility and support systems, must be able to withstand the extreme wind pressures and windborne debris associated with a tornado.

The project architects, Eubanks & Harris Architects, Inc., consulted FEMA 361: *Design and Construction Guidance for Community Shelters* to determine the specific design loads that the new communications and emergency operations center would have to be able to withstand. The facility's exterior walls and roof were designed to resist 250-mph (3-second gust) wind speeds and the impact of a 15-pound wood 2x4 traveling at 100 mph. Smith County's new facility will be eight times stronger than "typical" structures in the area built in compliance with the local building code, which requires buildings to resist 90-mph (3-second gust) wind speeds.

Erection of the reinforced ICF walls.

For the exterior walls, the architects chose to use a reinforced insulating concrete form (ICF) wall system. This type of wall system not only provides the needed strength to resist high-wind pressures and windborne debris impacts, but also has superior thermal resistance (R-rating) and sound reduction qualities.

The core of the facility contains the command center, breakout rooms, vault, and restrooms. Given the importance of the command center, the architects took the extra step of specifying ICF construction for the core area, thereby providing two layers of protection for the command center.

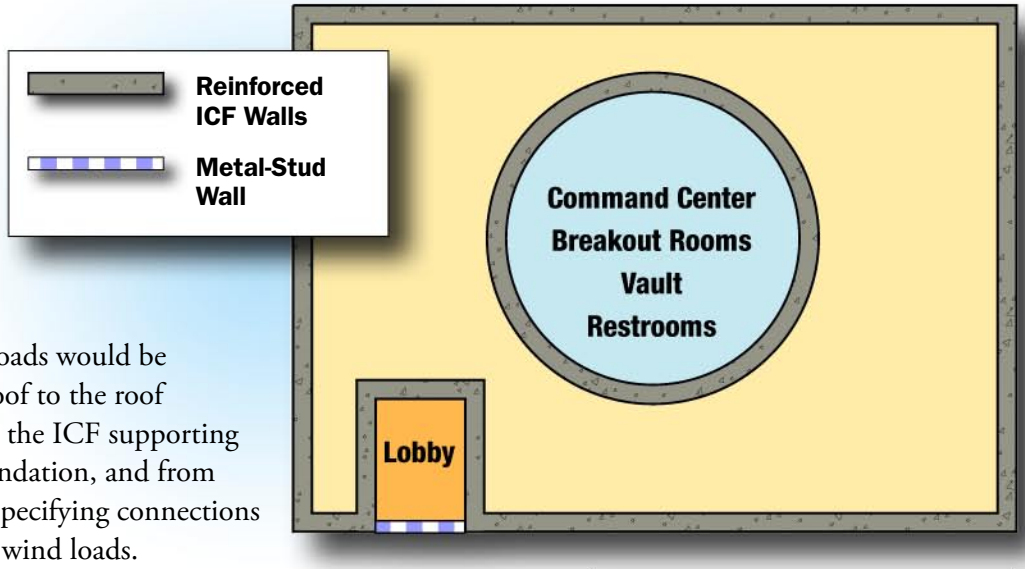


FEMA 361

Completed reinforced ICF walls.

Hardened First Responder Facility

The steel-truss roof system is rated to resist wind uplift pressures of 360 pounds per square foot (psf) versus the 90 psf used for general design. A reinforced concrete roof provides protection from windborne debris.



The architect's design ensured that loads would be transferred from the concrete slab roof to the roof structure, from the roof structure to the ICF supporting walls, from the ICF walls to the foundation, and from the foundation into the ground by specifying connections capable of transmitting the extreme wind loads.

All exterior windows and doors and security interior doors are bulletproof. The architects took great care to ensure that the window and door frames would be adequately connected. All exterior doors were specified to have six points of connection: three hinge points and three latching points as recommended by FEMA 361: *Design and Construction Guidance for Community Shelters.*

The lobby is designed to minimize the effects of a bomb blast in the lobby. The interior walls between the lobby and the facility will be hardened, while the exterior wall of the lobby will be of lighter, metal-stud construction. In the event of an explosion, the exterior wall would be blown out, directing the blast pressures away from the structure.

Construction of the steel-truss roof system.

Communications

An EOC serves as the central point for decision-making and coordination of response activities during and after an emergency or disaster; therefore, adequate communications capabilities are an essential part of EOC design. Required communications equipment includes telephones, radios, computers, fax machines, copiers, cellular phones, satellite phones, and supporting equipment such as batteries and chargers. Sufficient electrical, telephone, and network lines must be provided to support this equipment, and they must be protected from known threats. For example, utility lines at the EOC site should be installed in secure locations and designed to withstand the effects of hazard events. In addition, local and state Wide Area Networks (LANs and WANs) should be protected from cyber attack.

Building System Design

Four key concepts should be considered in the design of building systems for a critical facility:

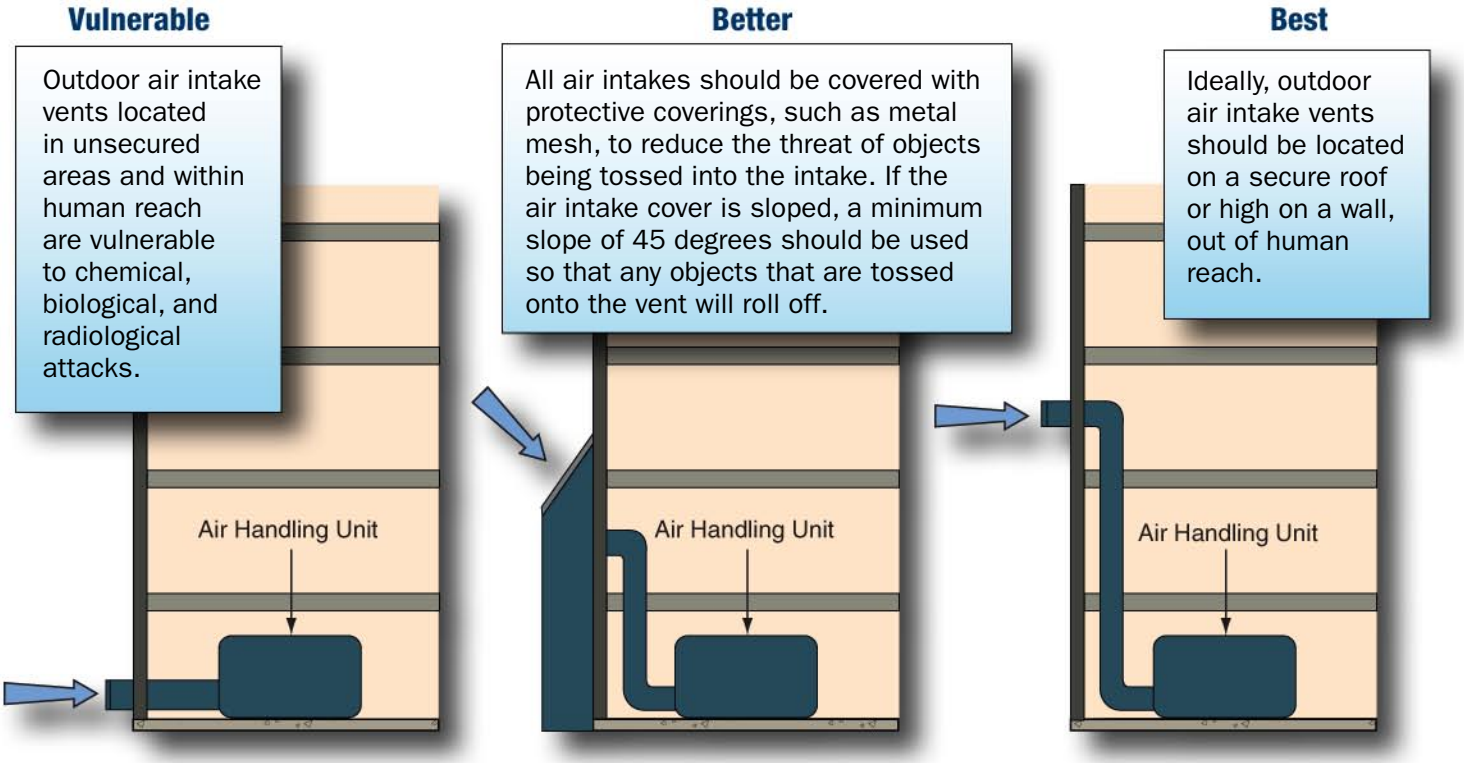
1. Backup systems should be provided.
2. All points of access to the systems – including entry points, control panels, and maintenance access – should be located in secured areas.
3. All systems should be protected from potential hazards.
4. All systems should be physically separated.

For example, Smith County's EOC will have an on-site emergency generator with the capacity to operate the entire facility and function independently from the normal electric service. The emergency generator will be housed in a secured, reinforced concrete masonry mechanical yard covered with a steel screen that will protect the generator from windborne debris impacts. In addition, external connections will be provided for portable generators that can supply power in case the backup generator fails.

A backup system will also be provided for the potable water supply. The facility will be connected to municipal water, but will also have a secured backup water well that can provide potable water if the municipal water service is interrupted or the water becomes contaminated or otherwise unusable.

The heating, ventilation, and air conditioning (HVAC) system will also include built-in redundant features to ensure that, if part of the system becomes inoperable, other units will be available to maintain the required temperature in areas of the building that contain sensitive equipment. In addition, the HVAC outdoor air intakes will be installed in secure areas.

The electrical, communications, and security systems will each have separate rigid conduits and control panels. This will minimize the likelihood of all systems being disabled by one incident.



SOURCE: DEPARTMENT OF HEALTH AND HUMAN SERVICES PUBLICATION: *Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks*

Controlling Access

Controlling access to an EOC is one of the most critical security concerns. The Smith County facility will have three levels of security access. The first level begins at the lobby and the employee parking area. An electronic access ID card will be needed to enter both areas. For visitors, the receptionist will be able to override the lobby security system and "buzz" them in. The second level of security access will require both an electronic ID card and an access code for entry into the facility from the lobby or the secured parking area. Entry into the command center and vault will require a third level of security access that incorporates an electronic ID card, an access code, and thumbprint recognition.

In addition to the various levels of access security, both the interior and exterior of the building will be monitored by video surveillance systems. Additional security will be provided by extensive exterior lighting, particularly at entrances and utilities, and near the limited vegetative cover allowed by the site plan.

One of the most important roles of the EOC is to disseminate information, particularly through the media. Disasters usually involve intense public interest, and EOC staff often must deal with media representatives who want updated information. Recognizing the importance of the media, Smith County included a special room for media interaction in the design of their facility. The media room will be accessible only from the secured employee parking area so that the media and general public are kept separate.

The secured employee parking area has been designed with additional space for media mobile units, and power outlets have been provided on the exterior of the building so that the mobile units can draw on the facility's power supply. Electrical outlets have also been provided in the media room. A lounge and restrooms will be accessible to media, but access to the remainder of the building will not be allowed.

Human Factors

During a crisis, emergency workers often work 12- to 15-hour shifts at an EOC and frequently need to remain there for several days, including overnight. Additionally, an EOC can be activated for prolonged periods of time. Therefore, the Smith County facility was designed to be self-contained for 2 weeks at a time. It is equipped with enough cots and mattresses for 25 people, and is stocked with enough food to feed up to 50 people for 2 weeks. Washers and dryers are also available on site for employees, as well as showers and separate dressing rooms.

The extended EOC stays often required of emergency workers, the urgency of emergency response, and the need to deal with injuries, loss of life, damage, and destruction, all place extreme pressure and stress on emergency managers and staff. Recognizing the effects of this difficult working environment, the Research and Planning Committee put high priority on keeping the staff as comfortable as possible during their stay at the EOC. As a result, in addition to basic accommodations, several other features were included in the design of the facility.

The committee members learned from their visit to Shreveport, Louisiana, that an exercise area for employees can be extremely beneficial in helping to relieve the tension emergency workers experience during a crisis. Caddo Parish employees were overwhelmingly positive about the availability of their exercise area and the relief that physical activity offers. Therefore, a similar feature was included in the Smith County facility.

In addition, the Research and Planning Committee visited an EOC in Florida that had an interesting amenity – a secured courtyard that allowed employees access to the outside. Secured outdoor environments of this type are particularly useful when the EOC is located in a high-crime area. Although Smith County's EOC is not in a high-crime area, a similar secured courtyard was included in its design. The open-air courtyard is adjacent to the break room and is surrounded by concrete masonry walls.

Useful References for Designing Critical Facilities

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http://www.huduser.org/publications/pdf/def.pdf

U.S. Department of the Treasury / Bureau of Alcohol, Tobacco and Firearms

Vehicle Bomb Explosion Hazard And Evacuation Distance Tables, 1999, send in a written request to the following to receive a copy: Bureau of Alcohol, Tobacco and Firearms, Arson and Explosives Programs Division, 800 K Street, NW, Tech World Suite 710, Washington, DC 20001

U.S. Navy

Design Manual (DM) NAVFAC (Naval Facilities Command), NAVFAC DM 2.08, ***Blast Resistant Structures***, December 1986
http://www.wbdg.org/ccbref/ccbdoc.php?category=nav&docid=46&ref=1

TechData Sheets - Naval Facilities Engineering Service Center (NFESC)
TDS-2062-SHR, ***Estimating Damage to Structures from Terrorist Bombs***, September 1998 [official use only] Requests for publication can be made to Naval Facilities Engineering Service Center, Security Engineering Division (ESC66), 1100 23rd Ave, Port Hueneme, CA 93043-4370, (805) 982-1582 (Primary), (805) 982-4817 (Alternate), (805) 982-1253 (Fax)

TDS-2063-SHR, ***Blast Shielding Walls***, September 1998 [official use only] Requests for publication can be made to Naval Facilities Engineering Service Center, Security Engineering Division (ESC66), 1100 23rd Ave, Port Hueneme, CA 93043-4370, (805) 982-1582 (Primary), (805) 982-4817 (Alternate), (805) 982-1253 (Fax)

TDS-2079-SHR, *Planning and Design Considerations for Incorporating Blast Mitigation in Mailrooms.*
For copies, contact Defense Printing Service, Building 40, 700 Robbins Avenue, Philadelphia, PA 19111-5094, (215) 697-2179 (Primary), (215)697-1462 (Fax)

The Smith County 911 Communications Dispatch and Emergency Operations Center nears completion.