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Principal Threats Facing Communities And Local Emergency Management Coordinators



**Federal Emergency Management Agency
Office of Civil Defense**

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PRINCIPAL THREATS FACING COMMUNITIES AND LOCAL EMERGENCY MANAGEMENT COORDINATORS

A Report to the United States Senate
Committee on Appropriations

April 5, 1990



Federal Emergency Management Agency
Office of Civil Defense

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SUMMARY

Under the language of Senate Report 101-128, Department of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriation Bill, 1990, which accompanied the 1990 Federal Emergency Management Agency (FEMA) appropriations bill, FEMA was directed to:

- ...prepare a study on the principal threats facing communities and local emergency management coordinators.*
- ...The study should rank the principal threats to the population according to region and any other factors deemed appropriate.*

THE THREATS

The United States is vulnerable to a wide range of threats. Periodic and at times little publicized disasters resulting from floods, tornadoes, landslides and fires take scores of lives and cause hundreds of millions of dollars in property damage annually. The magnitude of major disasters such as Hurricane Hugo and the Loma Prieta earthquake in California serve to heighten the realization of the vulnerability of the United States to such events when viewed in relationship to the loss of life, severity of property damage, disruption of services, and long-term impact on the affected population.

These facts are further complicated by advancements in technology and the increased development and use of chemicals over the past decades which have led to the rise of a new and wide range of technological threats virtually unknown 20 or 30 years ago.

Yet even major disasters such as Hugo and Loma Prieta pale beside the damage that could be inflicted by a calculated, purposeful and sustained attack on the United States. Ongoing variables on the international scene pose continuing threats to the security of the United States. The Soviet Union still retains an undiminished nuclear arsenal capable of widespread devastation if directed towards this country. The advancing missile capability of Third World countries poses yet additional dangers to the United States in view of the ability some countries have to obtain chemical, biological or nuclear warheads for these missiles. According to the Congressional Research Service of the Library of Congress, in a

1988 report on missile proliferation, even the continental United States could be within the range of ballistic missiles from a few additional countries by the year 2000.

TYPES OF THREATS

The United States is faced by three primary types of threats: *natural, technological and national security*. The largest single category of repetitive threats to communities and emergency management coordinators is *natural threats*. They pose a threat to any area of the country, their impact can be localized or widespread, predictable or unpredictable. The damage resulting from natural disasters can range from minimal to major (depending on whether they strike major or minor population centers). Depending on their severity, the impact of natural disasters can have a long-term effect on the infrastructure of any given location. Threats in this category include: avalanche, dam failure, drought, earthquake, flood, hurricane/tropical storm, landslide, subsidence, tornado, tsunami, volcano, wildfire, and winter storm.

Possessing much the same unpredictability as natural threats, *technological threats* represent a category of events that has expanded dramatically throughout this century with the advancement of modern technology. Technological threats include: hazardous materials incidents at fixed facilities, hazardous materials incidents resulting from transportation accidents, power failure, radiological incidents at fixed facilities, radiological incidents resulting from transportation accidents, structural fires, and transportation accidents of all types.

The potential for damage resulting from *national security threats* ranges from the relatively localized damage that could be expected to result from a low-intensity conflict (including terrorism, subversion, insurgency or drug trafficking) to the catastrophic devastation that could be expected to occur from either a chemical, biological or nuclear attack on the United States. Like the other categories of threats, national security threats can be either predictable or unpredictable (e.g., a preemptive strike *versus* an attack following a buildup of tensions). National security threats include: nuclear attack, chemical and biological warfare, civil disorder and low-intensity conflict.

LOSSES CAUSED BY DISASTERS

The magnitude of the losses caused by natural and technological disasters in the United States are staggering.

In the four-year period from 1983 - 1987, 2,300,000 fires were reported in the United States. Average annual losses during this period included 5,800 *civilian fire deaths*, 29,000 *civilian injuries*, and \$7.3 billion in *property damage*.

During the period 1900 - 1982, nearly 13,000 people lost their lives in hurricanes from Texas to the northeast; property losses from hurricanes during the period 1900 - 1989 exceeded \$43 billion.

From 1953 to 1987, 25,253 tornadoes struck the United States. In the southern States alone, from North Carolina due west to Texas, 11,599 tornadoes hit, while 10,525 tornadoes struck the mid-western region (North Dakota, South Dakota, Nebraska, Iowa, Missouri, Kansas, Illinois, Indiana, Wisconsin, Minnesota, Michigan, Ohio, and Kentucky). The Upper Northwestern States, including Alaska, Washington, Oregon, Idaho, Montana, and Wyoming, an area generally not associated with tornado activity, were struck by 608 tornadoes during the same period.

Average annual losses from landslides total \$1-2 billion, while flood losses reach an estimated \$344 million. Tornadoes result in average annual losses in excess of \$500 million. Highway hazardous materials incidents alone result in average annual losses of \$17.1 million.

In addition to the average annual fire deaths of 5,800 persons, the United States can expect the following average deathrate from various threats: (1) 163 from floods; (2) 98 from tornadoes; (3) 88 from winterstorms; (4) 25-50 from landslides; (5) 33 from hurricanes; and (6) 14 from transportation accidents involving hazardous materials.

A number of specific disasters have caused extraordinary deathrates. A hurricane in Galveston, Texas, in 1900 resulted in 6,000 deaths. Over 2,200 people died from a dam break and resultant flooding in Johnstown, Pennsylvania, in 1889. A severe wildfire in Wisconsin in 1871 was responsible for the loss of 1,182 lives. Over 700 people died in the San Francisco earthquake in 1906.

These examples of losses of life and property, whether taken in historical perspective or viewed in terms of annual or average annual losses, are indicative of not only the wide range of threats facing the population, but the severity and magnitude of the impact such disasters can inflict on the population.

RANKINGS

An effort has been made to be responsive to the Committee's direction to "...rank the principal threats to the population according to region and any other factors deemed appropriate." However, it is important to note that any ranking of the threats to communities and emergency management coordinators is potentially misleading because of: (1) the wide variations that can occur with the application of different criteria to the same threat; (2) the significant differences that can occur from the impact of a particular threat on a region and the individual States within that region; (3) the fact that threats in one region are not necessarily applicable to another region; (4) variances in the types of data collected on each threat; and (5) the lack of available data in some cases with which to develop a reasoned ranking. The variances in or lack of available data were critical factors which hampered attempts to make viable rankings of threats by region.

Relative rankings of threats by regions were also particularly difficult because of the wide variations resulting from frequency of occurrence; the level of preparedness maintained by communities in areas vulnerable to various threats; the degree to which disasters strike urban or largely rural, sparsely populated areas; perceptions of local emergency managers regarding the potential severity, magnitude or rankings of particular threats in reports they make to FEMA; the impact of "worst case" disasters on considerations of their rankings as significant threats; and the potential critical danger of a particular threat which may, in fact, occur only infrequently.

State and local emergency coordinators listed in equal ranking floods, power failures and transportation accidents involving hazardous materials as the three most critical threats they face, regardless of region. The second most serious threats, again of equal ranking among all regions, were wildfires, winter storms, dam failures and hazardous materials accidents at fixed facilities. Transportation accidents (air, rail, etc., but not including hazardous material accidents) and structural fires ranked third in all regions. Nuclear attack is listed as the fourth ranked threat by local emergency managers in all 50 States and the District of Columbia. Fifth-ranked threats include drought and fixed facility hazardous materials incidents. Tornadoes ranked sixth based on these reports.

*FEMA'S MISSION – PREPAREDNESS, MITIGATION,
RESPONSE & RECOVERY*

The Federal Emergency Management Agency is responsible for ensuring the establishment and development of policies and programs for emergency management at the Federal, State and local levels. This includes the development of a national capability to mitigate against, prepare for, respond to and recover from the full range of emergencies, including natural and technological disasters and national security emergencies, including nuclear attack.

In view of the broad range of threats facing the population and industry of the United States, the Federal Emergency Management Agency is also responsible for ensuring that plans are in place as part of an integrated, all-hazard emergency management program. While the nature of some emergencies (e.g., earthquakes, hurricanes, tornadoes, radiological emergencies, etc.) does require certain hazard-specific procedures and activities, the goal of the Agency is to ensure the establishment of an integrated, all-hazards emergency management capability.

The Agency has a wide range of programs available to provide financial and technical assistance to State and local governments. The purpose of these programs is to assist State and local emergency managers in coordinating the mitigation, preparedness, response and recovery activities of their governments against the numerous threats facing their communities.

INTRODUCTION

As part of the review process for the Fiscal Year (FY) 1990 budget of the Federal Emergency Management Agency (FEMA), the Senate Appropriations Committee (hereinafter referred to as the “Committee”) directed that FEMA undertake a study of the principal threats facing communities and local emergency management coordinators. The specific task was as follows:

The Committee directs FEMA to prepare a study on the principal threats facing communities and local emergency management coordinators. The Committee understands that certain natural and man-made disasters threaten communities with a varying degree of severity and frequency. The study should rank the principal threats to the population according to region and any other factors deemed appropriate.

Background

On a daily basis, the population of the United States is at risk from a broad spectrum of threats. The scope of these threats ranges from the impact of a housefire in an individual residence to a hazardous materials incident, perhaps on an Interstate highway, to the impact on many thousands of square miles affected by a catastrophic natural disaster such as a major earthquake. It also includes the single potentially most threatening event of all — attack, including nuclear attack.

And what is the impact of these threats on the population and the government of this country? The rapid technological growth in the United States during this century has resulted in the development of an infrastructure that is tightly interconnected by vast systems of sophisticated communications, transportation, industry, government and economic integration. This infrastructure is continually exposed to disruption — or destruction in the event of strategic nuclear attack — as a result of the full range of threats facing this country. The concurrent urbanization of the United States, particularly since World War II, has substantially exposed ever increasing numbers of people to the impact of a particular threat in a given area.

These points were brought home vividly in the Fall of 1989 with the impact of Hurricane Hugo on the Virgin Islands, Puerto Rico, and North and South Carolina and the Loma Prieta earthquake in the San Francisco Bay area. Television brought the scenes of devastation into the homes of millions of people. In the case of Hurricane Hugo, people were able to watch the landfall of Hugo and witness the tremendous winds and destruction as they occurred. In succeeding days, they saw the scope of the damage inflicted by the hurricane, including the disruption of governmental services, communications, transportation and industry. Minutes after the Loma Prieta earthquake rocked the San Francisco Bay area, millions of viewers were able to see the destruction on bridges, the major fire in the City of San Francisco, and the rescue efforts on a major road system that had collapsed. The magnitude of the destruction in these incidents provided significant evidence of the continuing dangers posed by the variety of threats to which this Nation is exposed.

Yet even major natural disasters such as Hugo and the Loma Prieta earthquake pale beside the damage that could be inflicted by a calculated, purposeful and sustained attack on the United States. This country has been fortunate enough to evade major warfare on its soil for over a century. As a result, many local emergency management coordinators may not fully comprehend the very different problems generated by war. The complexity of warfare, be it conventional, nuclear, chemical or biological, is well beyond the scope of simply scaling up our responses to natural or technological disasters. Civilian attack defense already includes nearly all aspects of other-hazard operations in addition to its own unique preparations and responses — an emphasis on natural and technological hazards alone does not automatically yield the necessary attack defense capabilities.

The Threats

For the purposes of this study, three major categories of threats will be discussed: natural, technological and national security.

Natural threats, the largest single category of repetitive threats to communities and emergency management coordinators, result from weather-, geological-, seismic-, or oceanic-related events. They affect any area of the country. Their impact can be localized or widespread, predictable or unpredictable. The damage can range from minimal to major (depending on whether they strike

rural or urban population centers). Depending on the severity of the incident, they can have a long-term impact on the infrastructure of any given location. They include: avalanche; dam failure; drought; earthquake; flood; hurricanes/tropical storm; landslide; subsidence; tornado; tsunami; volcano; wildfire; and winter storm.

Technological/man-made threats represent a category of events that has expanded dramatically throughout this century with the advancements in modern technology. Like natural threats, they can affect localized or widespread areas, are frequently unpredictable, can result in substantial loss of life (in addition to the potential for damage to property), and can pose a significant threat to the infrastructure of a given area. Technological/man-made threats include: hazardous materials incidents at fixed facilities; hazardous materials incidents resulting from transportation accidents; power failures; radiological incidents at fixed facilities; radiological incidents resulting from transportation accidents; structural fires; and transportation accidents of all types.

National security threats represent those threats that are primarily the result of actions of external, hostile forces on the land, population or infrastructure of the United States. The potential for damage resulting from national security threats ranges from the relatively localized damage that could be expected to result from a low-intensity conflict (including subversion, insurgency, terrorism and drug trafficking) to the catastrophic devastation that could be expected to occur from either a chemical, biological, conventional or nuclear attack on the United States. Like natural or technological/man-made threats, national security threats can be either predictable or unpredictable (for example, a preemptive strike versus an attack following a buildup of tensions). National security threats include: nuclear attack; chemical/biological warfare; low-intensity conflict; and civil disorder.

The Nature of Threats

A single threat cannot be viewed as a constant, either in terms of the potential for damage to property, loss of lives, or the preparedness measures that must be undertaken to protect the population and infrastructure. For example, the State of Texas experienced 4,350 tornadoes during the period from 1953 to 1987, a significantly higher number than registered for any other State. However, these tornadoes often touched down in rural or sparsely populated areas, resulting in very limited amounts of damage. Conversely, a

single tornado or outbreak of tornadoes in a more urbanized area can result in tremendous losses of life and property, as can be seen in the following example.

Ohio sustained a significantly lower number of tornadoes than Texas during the period 1953 to 1987 — a total of 497. Yet, in April 1974, during an unusually severe outbreak of 144 tornadoes in a two day period, the city of Xenia, Ohio, suffered 33 deaths, 1,200 structures demolished, 1,500 structures damaged and total damage reaching an estimated \$70 — \$90 million (according to American Insurance Association estimates). Had the same outbreak of tornadoes occurred in a relatively isolated area, the losses would have been considered negligible at best.

A threat also cannot be viewed as an isolated event resulting in a predictable kind of damage, i.e., each one can trigger a series of other related incidents that can substantially increase the impact of the original threat. Such secondary events could, in fact, result in significantly higher death rates or substantially increased damage. The following are some classic examples of the “secondary effects” of a variety of threats:

- In 1964, the Prince William Sound earthquake in Alaska generated a marine landslide which undermined the Valdez Delta. A total of 122 persons in Alaska, Washington, Oregon, California and Hawaii were drowned in the tsunami resulting from the marine landslide.
- The Mount St. Helens eruption in 1980 generated the largest landslide in recorded history — 2.8 million cubic feet of rock. This has resulted in three “natural” dams which, in the opinion of the U.S. Geological Survey, are extremely unstable and likely to collapse and release millions of gallons of water from the lakes which have formed behind the dams.
- The extensive and widespread blow-down of timber resulting from the impact of Hurricane Hugo in 1989 has resulted in a potentially critical fire hazard in South Carolina.
- As a result of the Loma Prieta earthquake in 1989, the U.S. Geological Survey has estimated that literally thousands of possible landslides have been formed to the south. The potential hazard of these landslides could be revealed if a severe coastal storm should occur.

Thus, communities and emergency management coordinators are faced with not only the threats themselves, but a wide variety of other factors which make the process of mitigating against, preparing for and responding to them far more complex.

The predictability of a hazardous event or the magnitude of its impact depends on the nature of the particular hazard itself. For certain types of natural threats such as tornadoes and hurricanes there is a seasonal association. For other threats such as earthquakes, there is no such relationship and predictability is nearly impossible. Technology has simply not progressed to the point where the timing of an earthquake can be predicted with any degree of reliability.

There is also a significant variance in the potential impact of a threat on a “prepared” jurisdiction *versus* an “unprepared” jurisdiction. For example, the earthquake preparedness and mitigation measures taken in San Francisco and Los Angeles have proven to be significantly effective in reducing the magnitude of losses from large earthquakes — high-rise structures in San Francisco built according to stringent earthquake building codes showed little to no damage during the Loma Prieta earthquake. Yet even though the seismic risk in Charleston, South Carolina, and the New Madrid Seismic Zone (including Missouri, Arkansas, Tennessee, Kentucky, and Illinois) is great, the lack of major seismic activity in these areas during this century has lessened the fear of the threat. Consequently, many of the jurisdictions in these areas have not implemented strong earthquake building codes like those in San Francisco and Los Angeles. Thus, the impact of a major earthquake in the future in the New Madrid Seismic Zone or around Charleston, South Carolina, could result in tremendous losses of life and property that could possibly have been avoided with more stringent preparedness and mitigation measures.

The same is also true for other types of threats. The erratic paths of some storms, taking them over areas not normally prepared to cope with such storms, or the infrequency of their occurrence can result in reduced warning times and/or preparedness measures. For example, inland cities such as Charlotte, North Carolina, do not normally expect to sustain major hurricane damage. Based on the original path of Hurricane Hugo, it was predicted to pass far to the east of the city, primarily along coastal areas. Yet Hugo followed an extremely erratic course and shifted, causing significant damage in Charlotte. Another example is that, while a major winter storm in the midwestern States could be disruptive, it may

not result in major damage since residents and communities in these areas are better prepared for such a storm. Conversely, a similar storm in the Deep South could result in higher death rates and major damage to roads, communications, transportation and utilities because of inadequate preparedness due to the infrequency with which major winter storms strike that area.

There is also no unanimity among experts as to the impact resulting from potential atmospheric and other environmental changes which could result from the long-term effects of elements such as *acid rain* and the *greenhouse effect*. There is, however, a growing consensus that weather trends on the African Continent, where most hurricanes that affect the continental United States form, will result in an increase in the frequency and severity of hurricanes hitting the United States mainland during the next decade.

Ongoing variables in the international scene pose continuing threats to the security of the United States. The Soviet Union still retains an undiminished nuclear arsenal capable of widespread devastation if directed towards this country. An estimated 17 or more nations may be nearing nuclear capability, inspection or verification of which is, in most cases, virtually impossible in hostile or unwilling countries. Some 20 countries may be producing chemical weapons today. An estimated 15 Third World nations now have the ability to produce or acquire mid-range missiles which could easily be fitted with nuclear, chemical or biological warheads. According to the Congressional Research Service of the Library of Congress, even the continental United States could be within the range of ballistic missiles from a few additional countries by the year 2000.

**Preparedness
Measures/
Hazard Mitigation
Activities**

Federal, State and local emergency managers must prepare their communities against the wide range of threats facing them on a daily basis, in spite of the numerous variables involved. Regardless of whether the emergency manager is preparing against the threat of a severe storm, a tornado or the ultimate threat — conventional or nuclear attack — there is one common denominator: *emergency management is like insurance — it may never have to be used, but if it is not available when needed the losses can be staggering.*

The civil defense program provides the primary means by which State and local governments can develop the infrastructure of emergency management personnel, facilities, communications,

hardware and systems to prepare for and respond to the full range of threats facing the population of the United States. State and local emergency management personnel funded by the civil defense program develop Emergency Operations Plans and procedures to prepare for, respond to and recover from natural and technological/man-made disasters and attack, including nuclear attack. The implementation in 1988 by FEMA's civil defense program of a survivable crisis management program has initiated the means by which each State and local jurisdiction will have the ability to direct, control, manage and coordinate emergency operations, both within the jurisdictions and in cooperation with other State and local governments and the Federal government.

Modern technology has significantly enhanced our ability not only to forecast the impact of some disasters, regardless of whether they result from natural, technological/man-made, or national security threats, but to take measures to reduce the potential loss of life and damage to the infrastructure. Our predictive ability with regard to severe storm conditions or the possibility of tornadoes resulting from them, has substantially enhanced the preventive and/or safety measures that can be taken by the population. The ability to project the path of hurricanes usually allows adequate time to undertake protective measures on structures and evacuations, thereby reducing the loss of life. Spring flooding can frequently be predicted based on the snowfall levels at higher elevations and forecast temperature levels.

However, the degree to which forecasting can contribute to predicting disasters varies. Technology has not progressed to the point where the timing or severity of an earthquake can be predicted with any degree of reliability. In spite of the mitigation measures that can be taken, such as applying strict standards in the construction of buildings, highways, and other structures, millions of residents in earthquake-prone areas throughout the country are still vulnerable to a sudden, unexpected occurrence.

Mitigation programs undertaken in response to a wide range of threats do, however, result in measurable savings in lives and property protected, regardless of whether the event can be predicted or not. Mitigation efforts such as earthquake resistant engineering were critical in reducing the loss of life in the Loma Prieta earthquake. Bridges, roads, and buildings that were built according to stringent earthquake standards stood up well during the earthquake, while those structures that had not been built according to strict standards did not fare as well, as witnessed by the Oakland freeway. Hurricane preparedness activities, including

media announcements, the dissemination of printed information for residents in threatened areas prior to impact, and floodplain management initiatives have gone far in reducing the impact of water/wind-related disasters in coastal and inland areas.

THREATS AFFECTING THE UNITED STATES

This section describes the primary threats which the United States faces and provides general information concerning the dangers posed by them.

There are numerous threats facing the nation's population and infrastructure. Threats can be widespread or localized, affecting one or more States. Periodic and at times little publicized disasters resulting from floods, tornadoes, landslides and fires take scores of lives and cause hundreds of millions of dollars in property damage annually. The magnitude of the losses of major disasters, such as Hurricane Hugo and the Loma Prieta earthquake in California, when viewed in relationship to the loss of life, severity of property damage, disruption of services, and long-term impact on the affected population, serve to heighten the realization of the vulnerability of the United States to such events.

The vulnerability to threats is further magnified by the fact that analyses of future trends in disaster prevention and preparedness are complicated by the identification of newer threats, some of which were virtually unknown 20 or 30 years ago. Advancements in technology and the increased development and use of chemicals over the past decades have resulted in the rise of a new and wide range of threats. Estimates of the impact of some of these threats are often difficult because of a lack of experience with them or a thorough knowledge of the full range of their impact. However, the extent of their effects have been demonstrated in recent tragedies in Bhopal, India, and Chernobyl in the Soviet Union.

For the purposes of this study, three major categories of threats will be discussed: natural, technological, and national security. Each class of threats is further broken down into specific incident types. For each type of incident, information is provided to define the hazard, its national frequency, regions at risk, season(s) in which it may occur, its effects, the worst recorded event, and relevant statistical information and discussion.

NATURAL THREATS

Natural threats, the largest single category of repetitive threats to communities and emergency management coordinators, result from weather-, geological-, seismic-, or oceanic-related events. They pose a threat to any area of the country; their impact can be localized or widespread, predictable or unpredictable. The damage resulting from natural disasters can range from minimal to major (depending on whether they strike major or minor population centers). Depending on their severity, the impact of natural disasters can have a long-term effect on the infrastructure of any given location. Natural threats include: avalanche; dam failure; drought; earthquake; flood; hurricane/tropical storm; landslide; subsidence; tornado; tsunami; volcano; wildfire; and winter storm.

Avalanche

Definition *A mass of sliding snow in mountainous terrain with large snow deposits on slopes of 20 degrees or more.*

National Frequency No national figure is recorded.

Regions at Risk The mountain ranges in New Hampshire, Vermont and the Far West experience avalanches where the primary risk to people exists in recreational areas that feature climbing and skiing.

Season(s) Fall, Winter, Spring.

Effects Few deaths have been recorded on an annual basis. Small structures, ski lifts, and personal property may incur damage. Snow-blocked roads may strand motorists. Snowbound inhabited areas might be cut off from food supplies and other life-saving resources.

Worst Event Definitive data unavailable.

Discussion Avalanches, which can be triggered by various means, including earthquakes, generally occur in the Rockies and other mountains of the western States. There is no centralized reporting of occurrences because most incidents happen in remote, sparsely populated locations and seldom inflict permanent damage. Avalanches remain a hazard threat, especially in ski recreational areas.

Dam Failure

Definition

Collapse or failure of an impoundment resulting in downstream flooding.

National Frequency Dam failures occur several times annually, however, no national average is available.

Regions at Risk There are over 80,000 dams throughout the States. Over 20,000 of them are classified as posing "high" or "significant" hazards. These designations mean that if such a dam failed, lives would be lost and extensive property damage would be suffered. *Figure 1* lists some of the dam and levee failures from 1874 - 1982 in which lives were lost.

Season(s) Dam failures usually occur as a secondary effect of storms or earthquakes.

**DAM & LEVEE FAILURES IN THE U.S.
1874 - 1982**

YEAR	LOCATION	STRUCTURE	DEATHS
1874	Williamsburg, MA	Earth Dam	144
1889	Johnstown, PA	Earth Dam	2,209
1890	Walnut Grove/Prescott, AZ	Dam	150
1894	Mill River, MA	Dam	143
1900	Austin/Austin, PA	Dam	8
1928	St. Francis, CA	Dam (est.)	400-700
1955	Yuba City, CA	Levee	38
1963	Baldwin Hill, CA	Earth Dam	5
1972	Buffalo Creek, WV	Slagheap Dam	125
1972	Rapid City, SD	Dam	200
1976	Newfound, NC	Earth Dam	4
1976	Teton, ID	Earth Dam	14
1977	Toccoa, GA	Earth Dam	35
1982	Estes Park, CO	Earth Dams (2)	3
TOTAL			3,528-3,778

Source: Adapted from U.S. Nuclear Regulatory Commission/
A Risk Comparison.

Figure 1

Effects

The primary consequence of the dam failure hazard is loss of life and property damage downstream of the failure. Of the estimated 80,000 dams in the United States, the greater majority of which are owned by State and local authorities, and private organizations as opposed to the number owned by the Federal government.

Worst Event

The Johnstown flood on May 31, 1889, resulted in the deaths of more than 2,200 persons.

Discussion

Between 1972 and 1981, the U.S. Army Corps of Engineers had the responsibility for the inspection of all non-Federal dams. The responsibility has since been returned to the States. Inspection of Federal dams continues to be the responsibility of the owner agency. The number of unsafe dams in 1981 is shown in *Figure 2*. It is important to note in the Figure, however, that the age of the data does not necessarily mean that the number of dams considered "unsafe" at the time of inspection remains at that level today — some deficiencies may have been corrected while other dams have become unsafe due to poor maintenance.

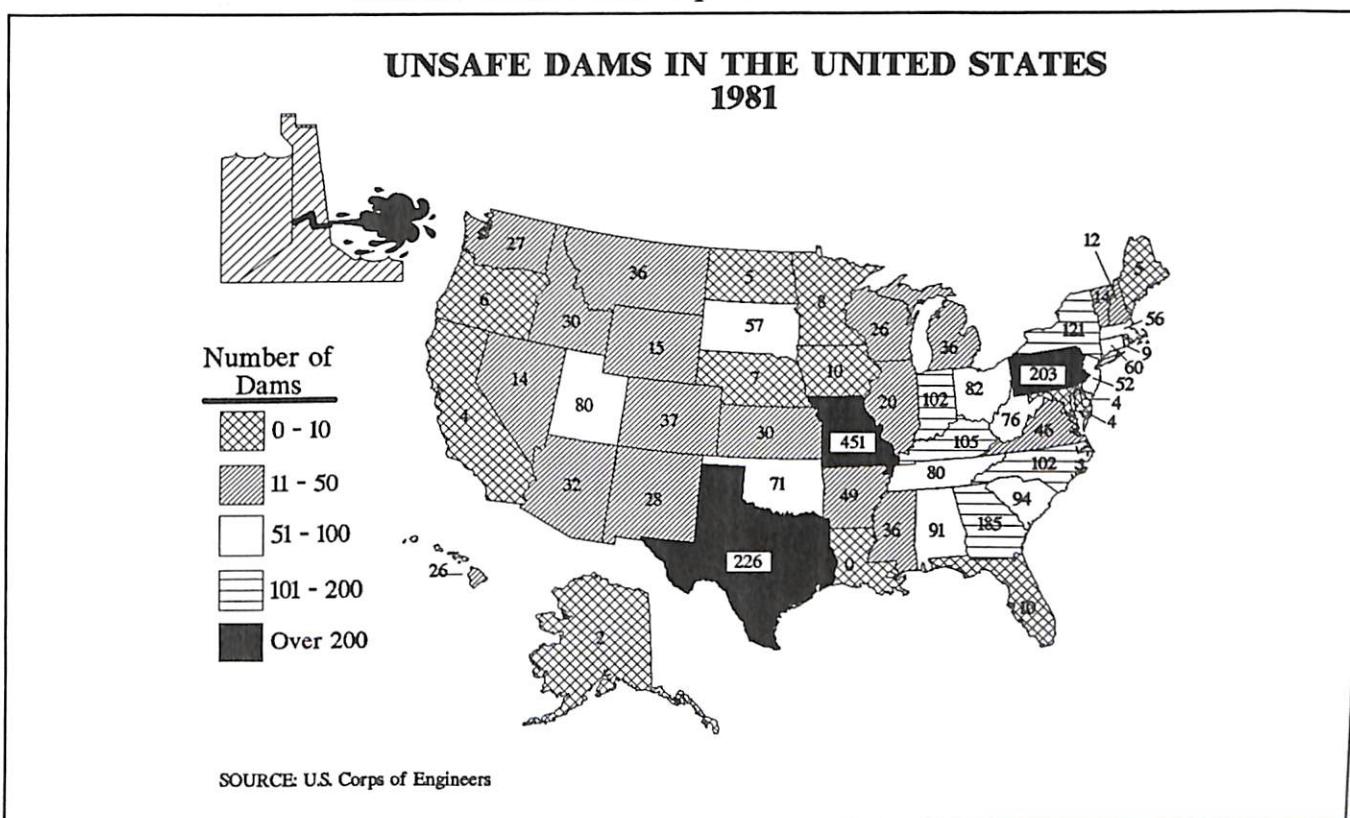


Figure 2

Drought

Definition	<i>A prolonged period without rain.</i>
National Frequency	The frequency is difficult to measure. Droughts can happen at any time of the year.
Regions at Risk	The entire country is at risk.
Season(s)	Year round.
Effects	Drought in the farm belt devastates crops, resulting in low yields and economic losses. Winds blow away top soil and create dust storms further eroding the fertility of the land. Water tables are lowered. Parched forest lands are more susceptible to wildfires during periods of drought.
Worst Event	“Dust Bowl” of the 1930’s in the Southwest.
Discussion	In 1988 losses resulting from drought totaled \$40 billion. The economic effects of a drought are both direct and indirect. For example, crop losses affect farming income which, in turn, may mean foreclosure of farms because of unserviced debt. Misuse of the land and lack of appropriate cultivation practices contributed to the severity of drought effects up until the last 50 years. Research, education, and governmental financial aid has done much to restore the land and mitigate the impact of droughts since then. The trend for droughts may worsen in the long term because of the greenhouse effect and cause water shortages for irrigation in the west and for human consumption throughout the country (especially in overdeveloped areas).

Earthquake

Definition *A sudden motion of the ground which may result in surface faulting (ground rupture), ground shaking, and ground failure.*

National Frequency Each year, there are literally thousands of earthquakes in the United States, most of which are of such small magnitude that they are not felt by the population.

Regions at Risk Earthquakes have occurred in most areas of the United States (see *Figure 3*). The most frequent earthquake events occur in States west of the Rocky Mountains, although historically the most violent earthquakes have occurred in the central United States. California is especially vulnerable because of its high seismic activity. Other highly vulnerable areas are those of Charleston, South Carolina, and the central United States (the New Madrid Seismic Zone), both of which were devastated by earthquakes in the last century.

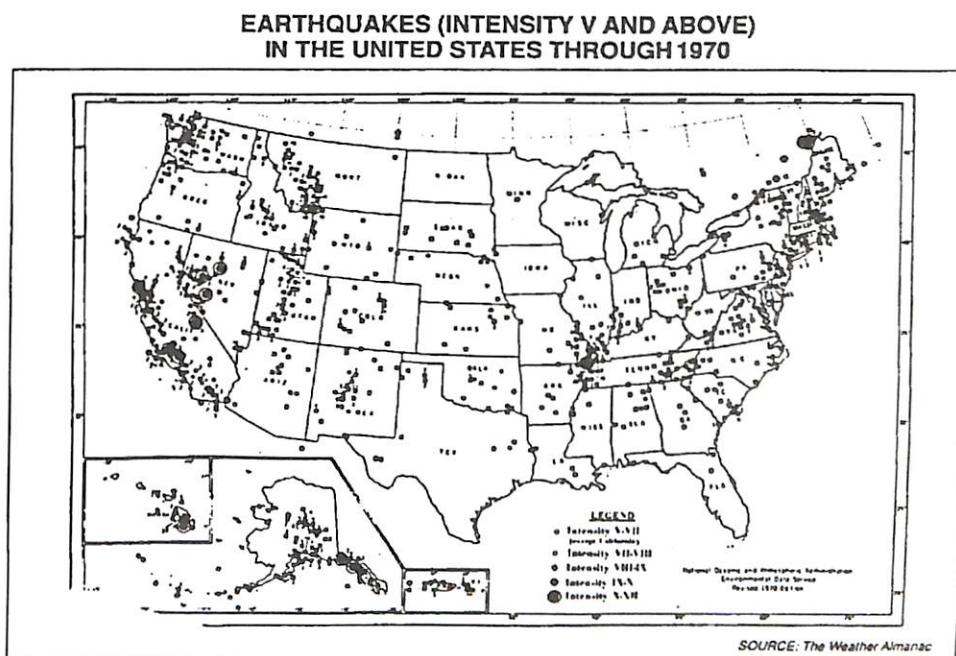


Figure 3

Season(s)

Year round.

Effects

The greatest danger to life in significant earthquakes comes from falling objects, broken glass, and structural failures. Severe earthquakes destroy power and telephone lines and gas, sewer, or water mains which, in turn, may set off fires and/or hinder firefighting or rescue efforts. They may also trigger landslides, rupture dams, and generate seismic sea waves (tsunamis).

Worst Event

The worst event for deaths occurred in the 1906 San Francisco quake when 700 lives were lost. The worst event for economic damage was the estimated \$10 billion loss caused by the 1989 Loma Prieta earthquake. *Figure 4 displays the 16 most significant earthquakes in the history of the United States and the number of deaths from each event.*

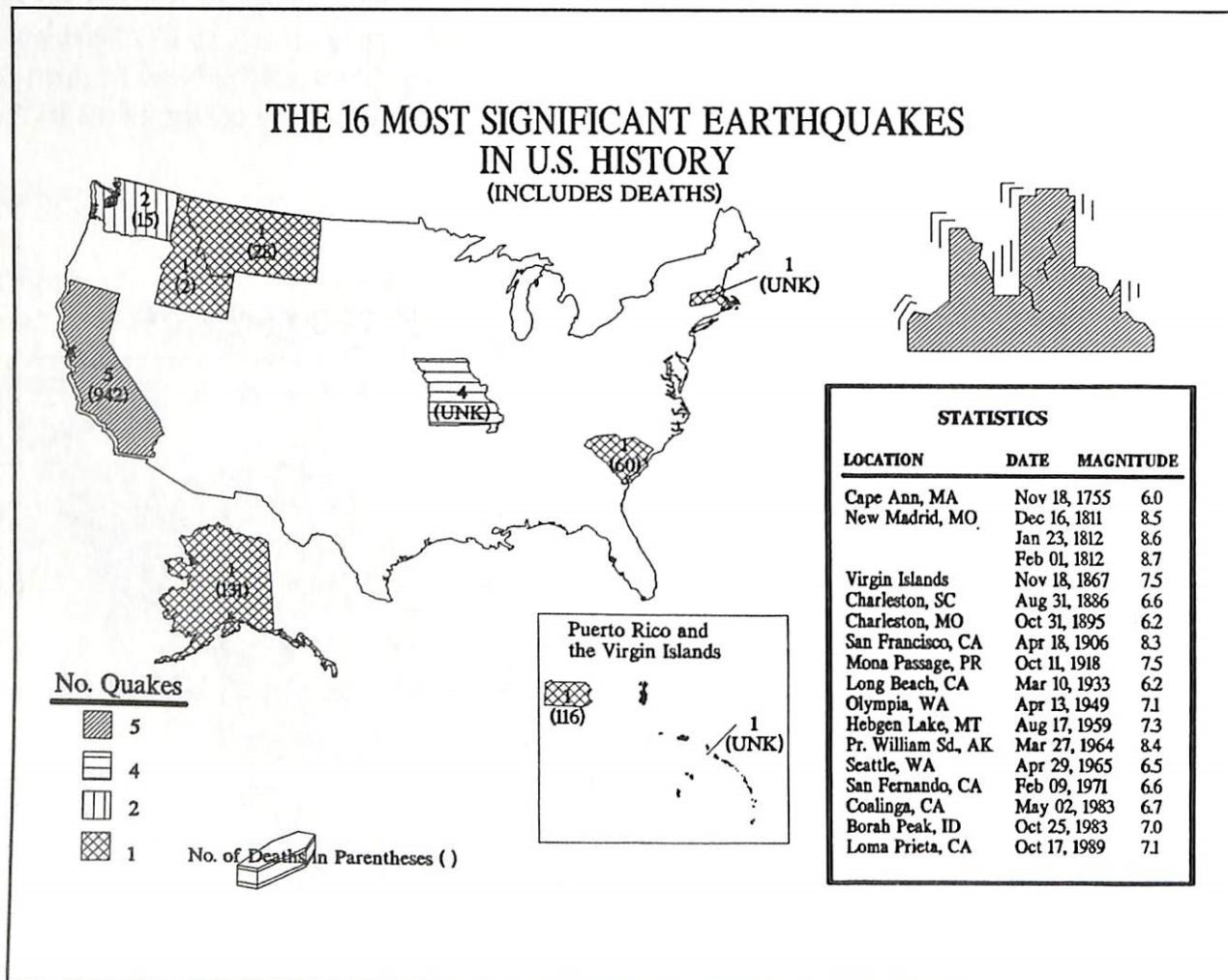


Figure 4

Discussion

Tens of potentially damaging earthquakes of a magnitude of greater or equal to 5 on the Richter Scale occur annually in the United States. For example, in a typical year such as 1982, 70 earthquakes of a magnitude of greater or equal to 5 on the Richter scale occurred throughout the country. Of these, there were 45 in Alaska, 22 in the contiguous 48 States, and three in Hawaii. Great magnitude earthquakes (greater or equal to 8 on the Richter Scale) are more infrequent, occurring in the United States on an average about once every 12 years.

Earthquakes occur in virtually all 50 States, Puerto Rico, and the Virgin Islands. They occur most frequently in California, Alaska, and the Caribbean in the grid of faults, chains of volcanoes and mountains, and deep oceanic trenches that represent the boundaries between the great crustal plates that form the Earth's outer shell. Intraplate earthquakes — shocks occurring within the interior of the giant crustal plates — are less common occurrences, but they can be equally destructive. Intraplate earthquakes are more typical of the types of earthquakes that occur in the eastern United States.

While earthquakes are relatively infrequent in the eastern States, an earthquake the magnitude of Loma Prieta could cause significantly more damage in the eastern States than it did in California. This is a result of unique factors in the East relating to the length of time it takes for seismic waves to diminish, which causes the ground shaking in the East to extend over much larger areas than for earthquakes of comparable magnitude in the West. For example, the distributions of intensities of the 1811 New Madrid, Missouri, earthquake and the 1886 Charleston, South Carolina, earthquake each were substantially greater than those of the 1906 San Francisco, California, earthquake and the 1971 San Fernando, California, earthquake.

Landslides, lateral spreads, differential settlements and ground cracks induced by earthquake ground shaking are a principal cause of damage and casualties. In the 1906 San Francisco, California, earthquake, lateral spreads and ground settlement were responsible for considerable damage in the city, including the breaking of several water pipelines that, in turn, left the city largely defenseless against the conflagration that followed.

Earthquake magnitude is a measure of the strength of an earthquake, or the strain energy released by it, as calculated from the instrumental record made by the event on a calibrated *seis-*

mograph. Seismographs record a zig-zag trace that shows the varying amplitude of ground oscillations beneath the instrument. Sensitive seismographs, which greatly magnify these ground motions, can detect strong earthquakes from sources anywhere in the world. The time, location, and magnitude of an earthquake can be determined from the data recorded by seismograph stations.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves caused by seismographs. Adjustments are included in the magnitude formula to compensate for the variation in the distance between the various seismographs and the epicenter of the earthquakes.

On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude of 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Earthquakes with magnitude of about 2.0 or less are usually called microearthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. Events with magnitudes of about 4.5 or more — there are several thousand such shocks annually — are strong enough to be recorded by sensitive seismographs all over the world.

Floods

Definition	<p><i>Four types of floods are included in this discussion.</i></p> <ul style="list-style-type: none">● <i>Riverine — periodic overflow of rivers and streams.</i>● <i>Flash — quickly rising small streams after heavy rain or rapid snowmelt.</i>● <i>Urban — overflow of storm sewer systems, usually due to poor drainage, following heavy rain or rapid snowmelt.</i>● <i>Coastal — flooding along coastal areas associated with severe storms, hurricanes, or other events.</i>
National Frequency	The frequency is undetermined, but there are numerous floods each year.
Regions at Risk	Floods occur in every State and territory.
Season(s)	Flooding can happen any time of the year, but predominates in the Spring.
Effects	The average annual death toll from flooding stands at 163. The average annual figure for economic damage, derived from losses during the years of 1925 through 1973, is \$344 million. Other effects from floods include crop damage and soil erosion. Flooding can also trigger secondary events such as power failure and landslide. In spite of risk reduction mitigation efforts for floodplain management, increasing numbers of households are at risk and increased damage is projected for the future.
Worst Event	The worst recorded event (loss of lives) was the 1889 flood in Johnstown, Pennsylvania, which resulted in the loss of more than 2,200 lives. (The flood itself was actually caused by the failure of a dam upstream from Johnstown. The flood is a classic example of the “secondary effects” that can occur from another event.) The worst economic losses were incurred in the 1972 floods that resulted from Hurricane Agnes (\$4 billion) and the 1973 spring flood of the Mississippi River system (\$1.2 billion).

Discussion

Flooding, perhaps the most pervasive natural hazard in the United States, occurs from a variety of causes. Floods often accompany hurricanes and tornadoes. While some floods develop over a period of days, "flash floods" can result in raging waters in a matter of minutes. *Figure 5* shows the percentage of flood-prone land mass in each State.

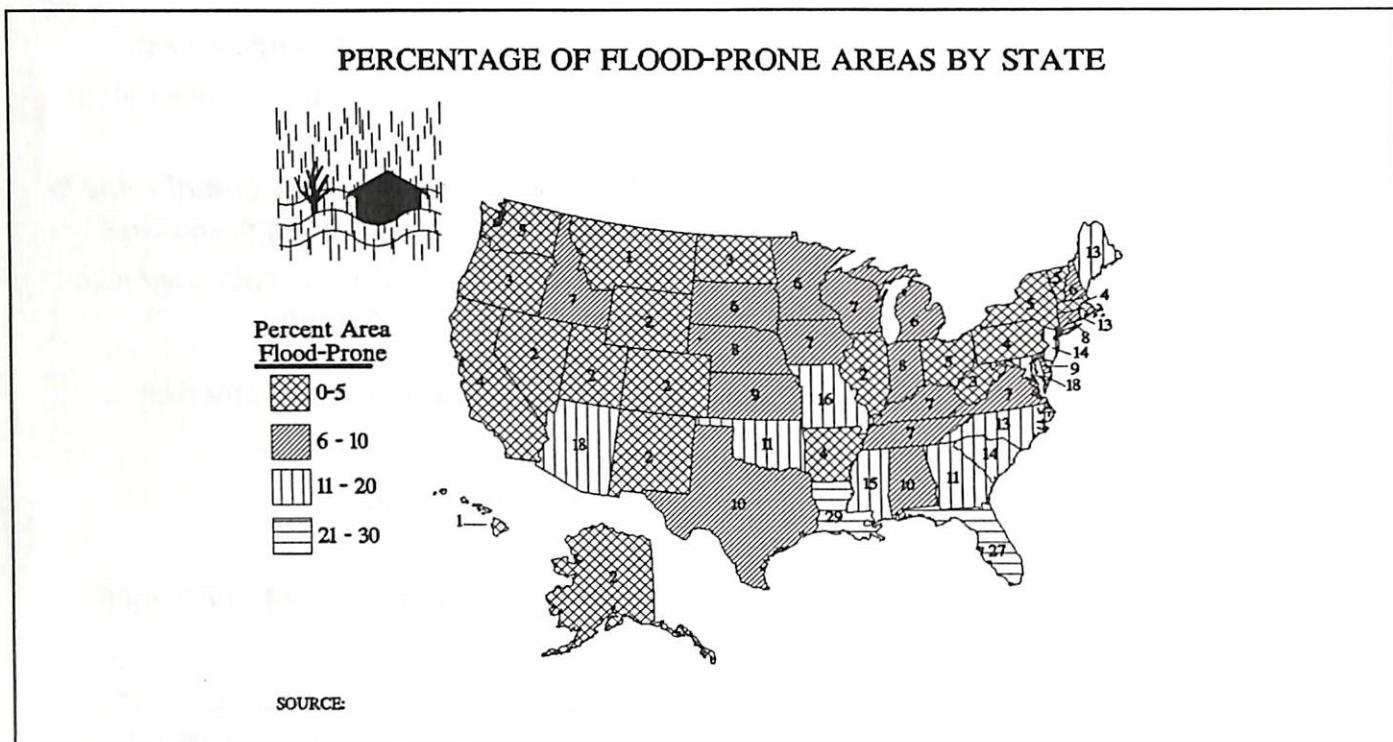


Figure 5

In an attempt to alleviate flood losses, Congress established the National Flood Insurance Program with the passage of the National Flood Insurance Act of 1968. The intent was to mitigate future damage and provide protection for property owners against potential losses through an insurance mechanism that was not formerly available. High-risk communities are required to enter into an agreement with the Federal government to implement measures to reduce future flood risk in Special Flood Hazard Areas. *Figure 6* provides State details for the flood land area, the 1987 floodplain households and the value of 1987 property at risk.

EXISTING PROPERTY AT RISK FROM FLOODING

STATE	FLOOD PLAIN LAND (Sq. Miles)	FLOOD PLAIN HOUSEHOLDS 1987	VALUE OF PROPERTY 1987 (MILLIONS)
Alabama	6,857	199,293	\$ 6,417
Alaska	1,263	8,161	492
Arizona	6,902	509,355	27,923
Arkansas	11,344	186,082	4,876
California	11,000	1,294,673	95,198
Colorado	2,271	77,628	4,333
Connecticut	563	119,766	7,071
Delaware	403	46,051	1,907
Dis. of Col.	12	32,789	1,776
Florida	22,172	1,332,169	65,612
Georgia	6,450	229,517	7,996
Hawaii	97	8,960	796
Idaho	1,276	22,872	915
Illinois	7,188	362,341	17,244
Indiana	3,791	228,596	8,417
Iowa	3,609	117,476	4,496
Kansas	5,611	109,193	3,736
Kentucky	3,400	123,871	3,876
Louisiana	17,616	638,787	26,097
Maine	2,422	64,042	2,097
Maryland	2,760	205,955	9,571
Massachusetts	1,464	31,204	13,632
Michigan	1,411	198,563	8,949
Minnesota	6,750	150,336	7,378
Mississippi	11,231	187,745	5,260
Missouri	7,514	205,913	7,602
Montana	2,415	21,782	762
Nebraska	3,569	173,833	6,780
Nevada	3,307	29,923	1,772
New Hampshire	544	31,252	1,328
New Jersey	1,636	502,764	23,108
New Mexico	3,152	81,228	3,612
New York	3,998	791,130	19,186
North Carolina	9,235	290,501	9,086
North Dakota	1,662	61,699	2,559
Ohio	3,033	298,908	12,119
Oklahoma	4,462	192,585	7,093
Oregon	3,354	88,768	4,352
Pennsylvania	2,569	359,118	12,500
Rhode Island	206	56,054	2,444
South Carolina	6,337	172,433	6,123
South Dakota	2,322	39,003	1,352
Tennessee	3,883	184,191	6,198
Texas	28,148	1,016,848	42,814
Utah	1,985	42,567	2,293
Vermont	524	19,784	714
Virginia	4,017	239,782	11,311
Washington	4,799	177,889	9,398
West Virginia	1,040	50,466	1,765
Wisconsin	5,374	173,217	7,455
Wyoming	2,489	13,327	640

Figure 6

Hurricanes/Tropical Storms

Definition

A large cyclonic storm accompanied by high winds, extreme rainfall, and storm surge.

National Frequency

The national average for hurricane incidents, based on figures from 1871 to 1980, is 1.7. During the same period, Florida experienced the largest number of hurricanes of any State, 51 — Texas was second with 32.

Regions at Risk

Vulnerable areas in the United States include the territories in the Caribbean, the coast from Texas to Maine, and tropical areas of the western Pacific Ocean, including Hawaii. (Typhoons, often believed to be the Pacific Ocean version of a hurricane, actually only occur in the area of the Philippines and the China Sea.) *Figure 7* depicts the number of hurricanes by State during the period 1871 - 1980.

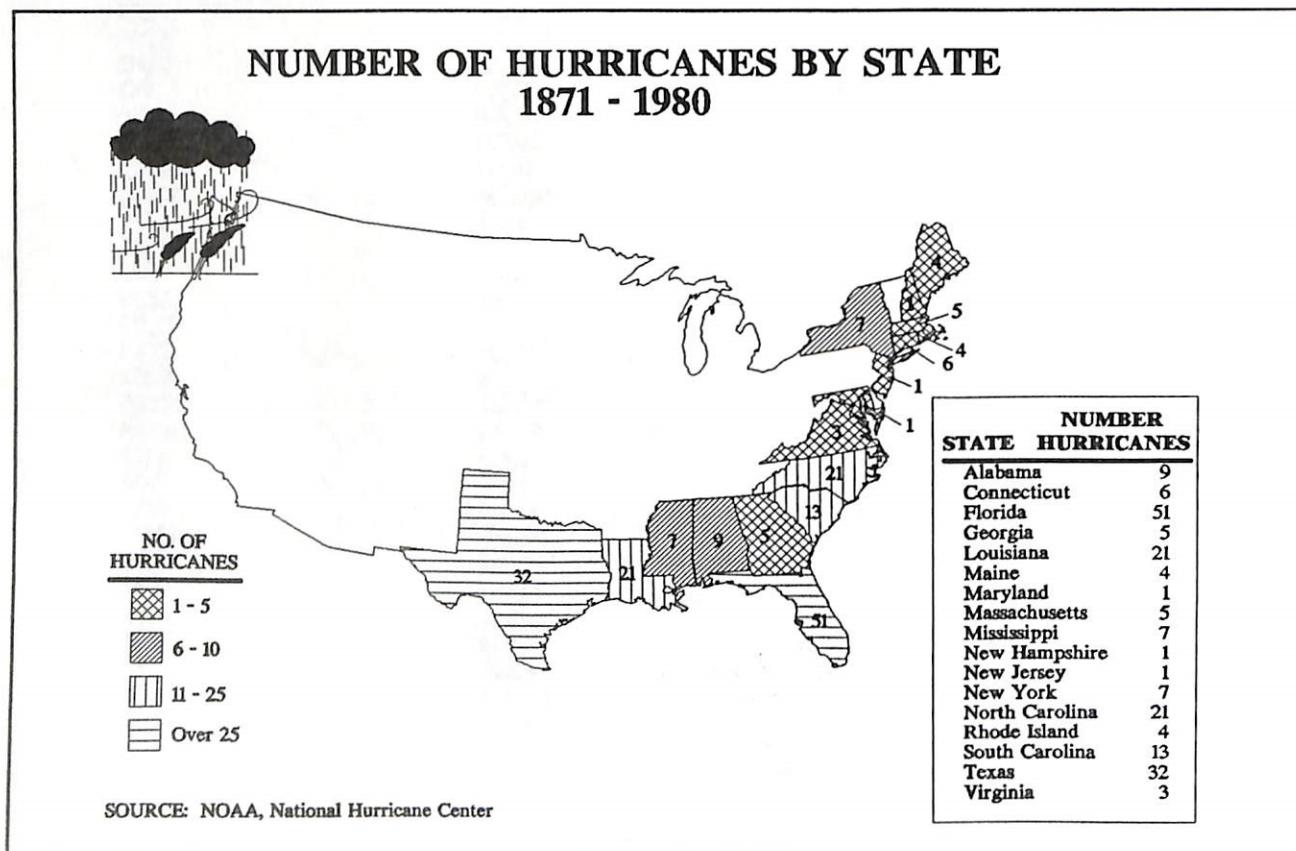


Figure 7

Season(s)	Summer and Fall. Hurricanes and tropical storms occur seasonally (June through November) with August and September being the peak months.
Effects	The consequences of hurricane winds and storm surge, which are often accompanied by other devastating events such as tornadoes, include loss of life, coastal erosion, coastal and inland flooding, structural failures, felled trees which cause other damage, power failures, and significant economic disruption. The annual rate of hurricane-related deaths is 33.
Worst Event	The worst event happened in Galveston, Texas, in 1900 when 6,000 lives were lost. The greatest economic damage resulted from Hurricane Hugo in 1989 with an estimated loss of \$10 billion. (<i>See Figure 8 for a list of the 20 costliest U.S. hurricanes during the period 1900 - 1989; note that hurricanes were not assigned names prior to 1951</i>).

THE 20 COSTLIEST U.S. HURRICANES, 1900 - 1989 (Adjusted to 1980 Dollars, in Billions)

HURRICANE	YEAR	DAMAGE
Hugo (VI, PR, SC, NC)	1989	\$10.000
Agnes (Northeast U.S.)	1972	4.700
Betsy (FL, LA)	1965	4.670
Camille (MS, LA)	1969	3.810
Diane (Northeast U.S.)	1955	3.086
New England	1938	2.632
Frederic (AL, MS)	1979	2.550
Carol (Northeast U.S.)	1954	1.733
Carla (TX)	1961	1.412
Donna (FL, East Coast)	1960	1.335
Celia (South TX)	1970	1.142
Hazel (SC, NC)	1954	1.057
Florida (Miami)	1926	.936
Eloise (Northwest FL)	1975	.880
Dora (Northeast FL)	1964	.850
Northeast U.S.	1944	.677
Beulah (South TX)	1967	.608
Southeast FL, LA, MS	1947	.516
Audrey (LA, TX)	1957	.510
Claudette (TX)	1979	.444

Figure 8

Discussion	Hurricanes are cyclonic storms with counterclockwise winds of 74 miles per hour or higher. The coastal areas that receive the full brunt of hurricane winds and storm surge sustain the
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most damage. Since hurricanes dissipate quite rapidly to less than hurricane strength after they make landfall, inland areas receive less severe damage, usually from flooding associated with the exceptionally heavy rains commonly associated with the remaining storm system.

Figure 9 contains data on the deadliest hurricanes, those causing 25 deaths or more (1900 to 1982).

DEADLIEST U.S. HURRICANES 1900 - 1982

HURRICANE	YEAR	CATEGORY	# OF DEATHS
Texas, Galveston	1900	4	6,000
Florida (Lake Okeechobee)	1928	4	1,836
Florida (Keys/S. Texas)	1919	4	600-900
New England	1938	3	600
Florida (Keys)	1935	5	408
Audrey (Louisiana/Texas)	1957	4	390
Northeast U.S.	1944	3	390
Louisiana (Grand Isle)	1909	4	350
Louisiana (New Orleans)	1915	4	275
Texas (Galveston)	1915	4	275
Camille (Miss., La.)	1969	5	256
Florida (Miami)	1926	4	243
Diane (Northeast U.S.)	1955	1	184
Florida (Southeast)	1906	2	164
Mississippi/Alabama/ Pensacola, Florida	1906	3	134
Agnes (Northeast U.S.)	1972	1	122
Hazel (S.C. & N.C.)	1954	4	95
Betsy (Florida & La.)	1965	3	75
Carol (Northeast U.S.)	1954	3	60
Southeast Florida, Louisiana, Mississippi	1947	4	51

Figure 9

Landslides

Definition	<i>Downward and outward movement of slope-forming materials composed of natural rock, soils, artificial fills, or combinations of these materials. The moving mass may be proceeded by any of three principal types of movement: falling, sliding, or flowing, or by their combinations.</i>
National Frequency	Precise data is not available, however, a report on “Reducing Losses from Landsliding in the United States”, produced in 1985 by the Committee on Ground Failure Hazards of the National Research Council, cited statistics which are representative of the magnitude of some of the major landsliding problems in recent years: <ul style="list-style-type: none">• In eastern West Virginia in 1969, a single storm associated with Hurricane Camille resulted in 1,534 landslides in one small drainage basin, the Spring Creek watershed.• Between 1966 and 1981, Orange County, California, experienced 40 major bedrock landslides that resulted in a total economic loss of over <i>\$40 million</i>.• Storm-triggered landslides in the Los Angeles area during the winters of 1951-52, 1957-58, 1961-62, 1964-65, 1968-69, 1977-78, and 1978-79 produced an average loss of <i>\$500 million</i> in each season of heavy storm activity.
Regions at Risk	According to the report of the Committee on Ground Failure Hazards of the National Research Council, “Landsliding is widely distributed in the United States and is not restricted to a few localized areas. Many different physiographic and climatic regions are subject to landslides, and in much of the United States landsliding is a dominant process of landscape alteration.” The same report stated that, “Landslides are indigenous to much of the Appalachian Highlands, particularly southwestern Pennsylvania, southeastern Ohio, and northern West Virginia. More than two million mappable landslides are estimated to have occurred in the Appalachian Highlands from New England to the Gulf coastal plain. These include landslides in the portions of the highlands that extend into

New England, New York, Maryland, Kentucky, Virginia, Tennessee, North Carolina, South Carolina, Georgia and Alabama.”

See *Figure 10* for a map of the regions at risk from landslides in the United States.

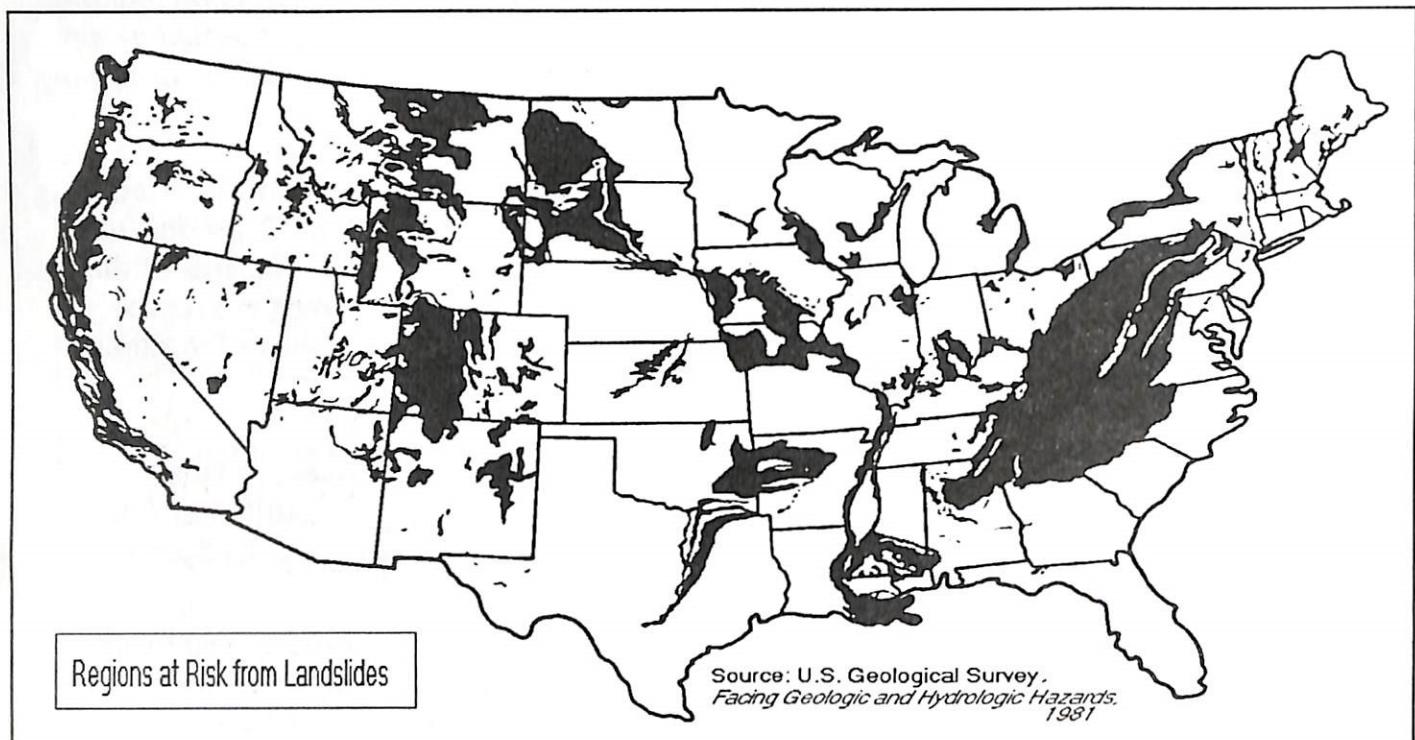


Figure 10

Season(s)	Year round.
Effects	The annual death rate from landslides is 25 to 50, with annual economic losses estimated at \$1 to \$2 billion. According to the National Research Council report mentioned above, “The loss of life from landsliding is comparable to the total loss of life from floods, earthquakes and hurricanes (Krohn and Slosson, 1976).” Economic losses are extensive, including not only the replacement and repair of damaged facilities but associated costs relating to lost productivity, disruptions to utility and transportation systems, and losses of revenue for affected communities.
Worst Event	In terms of sheer volume (2.8 billion cubic meters), the collapse of the northern part of the cone of the Mt. St. Helens volcano immediately before the May 18, 1980, eruption is the

world's largest landslide in historical terms (because of evacuation and other preparedness measures taken beforehand, only 5-10 people were killed by the landslide).

Discussion

Landslides can occur either very suddenly or slowly. They can be triggered during earthquakes, heavy rainstorms or rapid snowmelt, volcanic eruptions, storm generated ocean waves or by other landslides. Landslides can also result from such triggers as freeze-thaw cycles, shrink-swell cycles, root wedging, animal burrows, natural erosion or deposition, or the thaw of ice-bearing soils such as permafrost. While most landslides are single events, more than one-third of the cases are associated with heavy rains or the melting of winter snows.

Although the term *landslide* is generally assumed to mean any slide of rock or soil down a mountainous or hilly location, the term actually encompasses a number of different types of earth movements. For example, lateral shifts, even in soil that appears to be nearly flat to the naked eye are, in reality, landslides. Such movement is often caused by heavy saturation or liquefaction of the soil resulting from heavy rains or snowmelt, but it can also be the result of an earthquake. Classic examples of lateral shifts occurred in Sylmar, California, during the 1971 San Fernando earthquake. Another type of landslide can result from the "rotational" movement of land. During the earthquake in Alaska in 1964, for example, acreage in some areas moved as much as 11 feet, yet the buildings standing on the land were undamaged. (It is believed that liquefied soil beneath the earth supported the buildings and absorbed much of the shaking resulting from the earthquake.)

Earthquake shaking can dislodge rock and debris on steep slopes, triggering rock falls, avalanches, and slides. Ground shaking can initiate shallow debris slides on steep slopes and, less commonly, rock slumps and block slides on moderate to steep slopes. Though rare, shaking can reactivate dormant slumps or blockslides. Earthquake shaking can also trigger soil avalanches in some weakly cemented fine-grained materials, such as loess, that form steep stable slopes under non-seismic conditions. (Source: *Earthquakes, Volcanoes, and Tsunamis — An Anatomy of Hazards*, by Karl V. Steinbrugge. Skandia America Group, 1982. pp. 69-72.)

The effects of landslides can be both dramatic and devastating. Large landslides in 1958, thought to be triggered by earthquakes, generated wave heights of as much as 1,720 feet

in Lituya Bay in southeastern Alaska. Most of the 150 people killed in Virginia in 1969 as a result of floods associated with the remnants of Hurricane Camille, were actually killed not by water but by blunt-force injuries caused by debris in the numerous debris flow avalanches caused by the heavy rain (Williams and Guy, 1973). In 1972, three coal-refuse impoundments at Buffalo Creek, West Virginia, collapsed during heavy rains. The flow of mud and debris resulting from this event traveled 24 km downstream, killing 125 people and leaving 4,000 homeless (Davies and others, 1973).

In the past two decades, the expansion of the population into seismic risk areas (including relatively flat terrain) and/or steeply sloping terrain has contributed to the increase of damaging landslides. Building residential and other structures in such terrain and developing irrigated landscape areas alter soil or hillside configurations and aggravate the instability of many slopes. Such development can also reactivate older landslides or create conditions for new landslides.

Subsidence

Definition	<i>Any vertical displacement or downward movement of a generally level ground surface resulting from either natural or man-induced surface or subsurface conditions.</i>
National Frequency	As is the case with landslides, definitive data on the annual frequency of subsidence is unknown. However, subsidence results in millions of dollars of damage each year, with additional millions being spent in mitigation efforts.
Regions at Risk	Subterranean limestone regions, active or abandoned underground mining sites, areas subject to other hazards such as earthquakes, or areas of extensive oil, gas or groundwater withdrawal are highly vulnerable to subsidence. States with the highest rates of subsidence activity include Alabama, California, Florida, Kansas, Louisiana, Missouri, Montana, New Jersey, Oklahoma, Pennsylvania, Tennessee, Texas, and Washington.
Season(s)	Year round.
Effects	While few deaths are recorded, the annual damage from subsidence nationwide is in the millions of dollars — the annual rate in Florida alone is \$10 million. The degree of damage resulting from subsidence depends on whether it occurs in an urban area or a rural, sparsely populated area. In the case of urban areas, extensive damage and disruption can occur to utility lines, residential or business areas, transportation systems, water canals and dams.
Worst Event	Because there are four major subsidence conditions found in the United States, a “worst event” is somewhat difficult to characterize. However, some of the most serious subsidence damages have resulted from the sinking of areas around abandoned metal or coal mines in Montana, New Jersey, Pennsylvania, Washington, and a tri-State area formed at the junctions of Missouri, Oklahoma, and Kansas.

Discussion

Subsidence has affected about two million acres of surface area in the United States. Approximately 92 percent of the subsided surface is identified as either forest, idle or agricultural land. The remaining eight percent (158,000 acres) is generally urban.

Subsidence can be caused by either natural or man-induced processes. Natural processes include the changes relating to alterations in the earth's crust, the dissolution of underground minerals, thawing of ground ice in permafrost, or alterations in the vegetative cover. Man-induced subsidence results from such activities as sub-surface mining, excessive pumping or removal of groundwater, extraction of gas or oil from underground reservoirs, drainage of wetlands, or the application of surface loads (like buildings) on compressible soils.

There are four primary types of subsidence conditions that are found in the United States:

- subsidence resulting from the removal of underground fluid such as groundwater, oil or gas;
- subsidence in organic wetlands;
- subsidence due to mining, particularly coal mining; and
- subsidence in *karst* terrain (subterranean limestone areas).

Subsidence rates can be either extremely slow, such as those resulting from long-term geological changes, or sudden. Subsidence resulting from the removal of underground fluids can often be nearly imperceptible in the early stages but will usually continue to be relatively slow as the condition worsens. Generally covering areas of tens of miles in diameter, such subsidence conditions are often gradual enough that damage to buildings or other structures is relatively light. These areas are, however, generally more susceptible to secondary damages such as flooding or inundation, particularly when they lie in floodplains or in low coastal areas.

The reclaiming of organic wetlands has resulted in allowing many metropolitan areas with limited available land to extend their boundaries by building on lands that would normally be considered unsuitable for construction. However, for some

urban areas, this is considered an acceptable risk and subsidence management is, therefore, factored into their considerations.

There are an estimated 220 counties in 42 States where underground mining activities create the potential for subsidence. This is the result of the removal of the solid materials within the mines, creating a void that is frequently unstable — once the solid material, such as coal, is removed, the weight of the materials above the mine are redistributed. The subsequent collapse of timbers, support columns or other such structures developed during the mining phase but no longer maintained results in subsidence of the land area above the abandoned mine.

Subsidence in subterranean limestone caverns can result from underground water percolating through the limestone walls and causing cavities or dissolving the materials, thereby weakening the support structure. Land overlying these caverns can collapse suddenly, forming sinkholes as much as 100 feet deep and 300 feet across.

As noted earlier, subsidence damage on an annual basis totals in the millions of dollars. Added to this total are the millions of dollars spent annually for mitigation and preparedness measures, particularly in urban areas with large areas of reclaimed wetlands. While modern technology is assisting in the mitigation effort, much remains to be done.

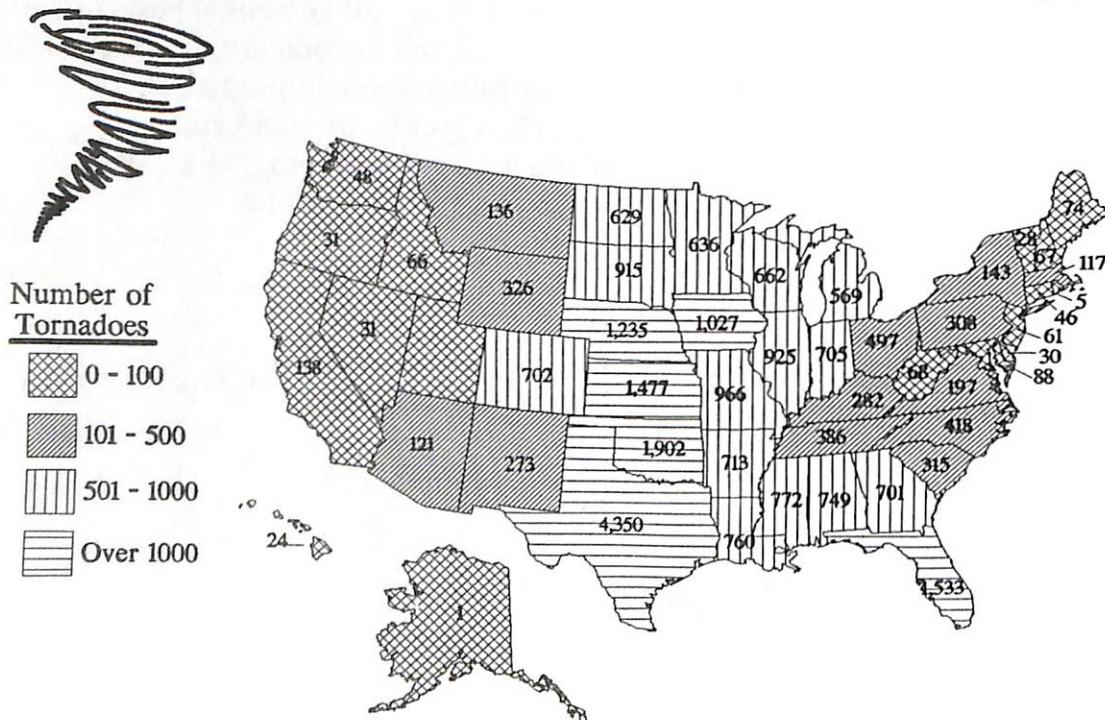
Tornado

Definition *A small radius cyclonic windstorm.*

National Frequency The yearly national average of incidents (taken from 1953-1987 data) is 748. The high of 1,102 was in 1973; the low was 421 in 1953. The average annual frequency per State is 21 with a high for Texas of 126 and less than 3 in 14 States.

Regions at Risk Tornadoes are a risk in all States but are more frequent in the Midwest, Southeast, and Southwest. The States of Mississippi, Kansas, Arkansas, Oklahoma, Illinois, Indiana, Iowa, Missouri, Nebraska, Texas, Louisiana, Florida, Georgia, Alabama, and South Dakota are at greatest risk. (See *Figure 11* for a national summary of tornado occurrences, 1953-1987, and *Figure 12* for 1989 tornado activity.)

NATIONAL SUMMARY OF TORNADO OCCURENCES, 1953-87



SOURCE: NOAA

Figure 11

GEOGRAPHIC DISTRIBUTION OF TORNADOES IN 1989

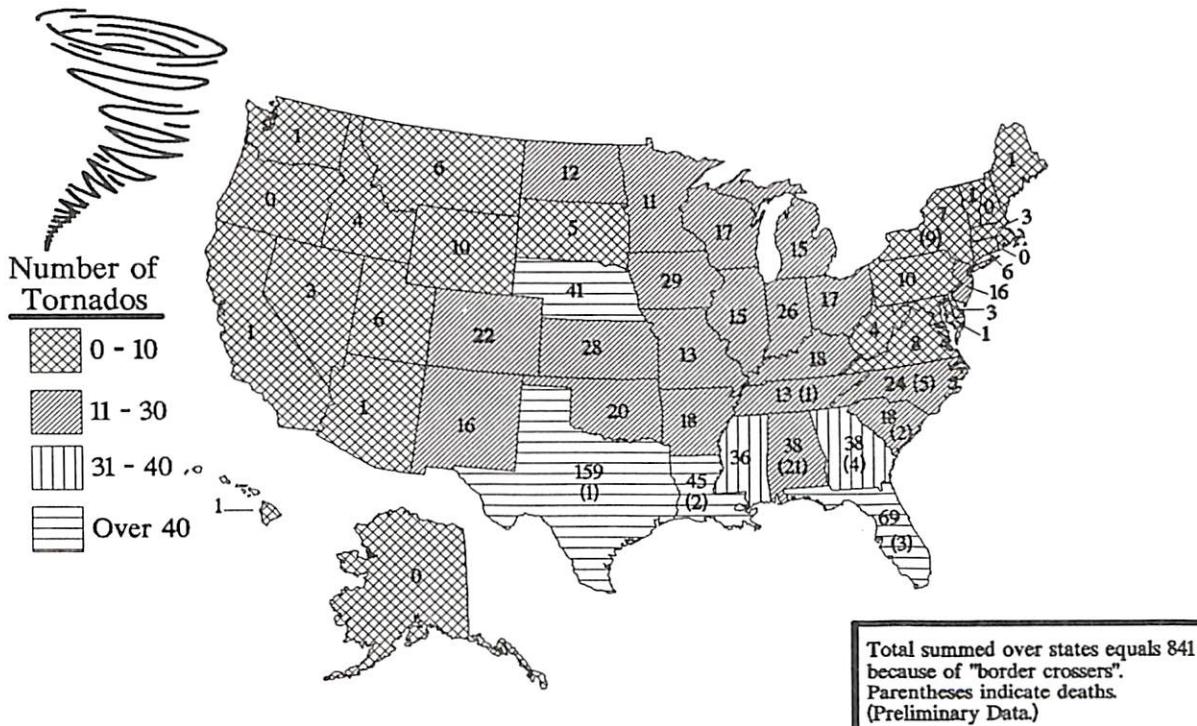
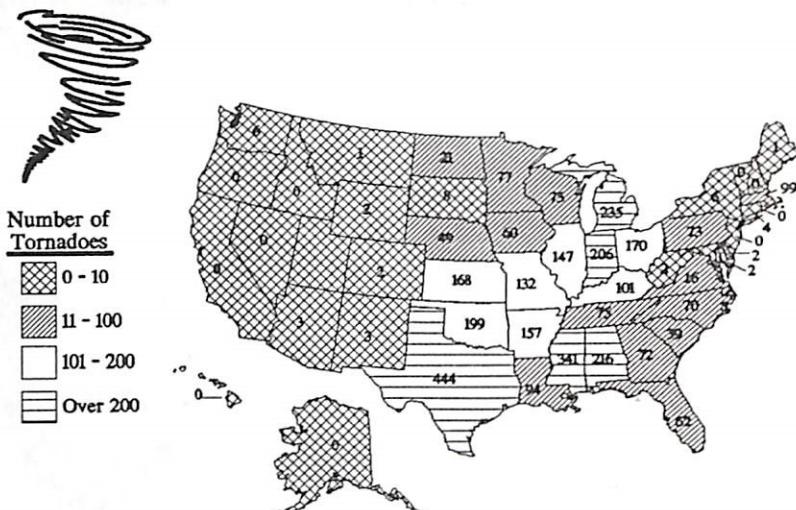


Figure 12

Season(s)	Tornadoes can occur year-around. While the normal tornado season extends from March to August, the peak months are from April through June.
Effects	The annual rate of deaths (averaged over the years 1953 to 1989) stands at 98. The annual rate of economic damage for the years 1965-1972 ranged from \$50 to \$500 million and over \$500 million for 1973 to 1975. Tornadoes cause secondary events such as power failure and fires. (See <i>Figure 13</i> for a summary of tornado deaths during the period 1953-1987.)
Worst Event	The worst event in this century occurred on March 18, 1925, when eight tornadoes in Missouri, Illinois, Indiana, Kentucky, Tennessee, and Alabama resulted in 689 deaths.
Discussion	While relatively short-lived in duration, tornadoes are intensely focused, making them one of the most destructive natural hazards. With winds of 150 miles per hour or more at their centers, tornadoes can destroy almost everything in their

NATIONAL SUMMARY OF TORNADO CAUSED DEATHS, 1953-87



SOURCE: NOAA

Figure 13

paths, which can range from 200 yards to one mile wide. Although tornadoes normally travel for up to 10 miles, tornado tracks of 200 miles have been reported.

More tornadoes occur in the United States than anywhere else in the world. They generally develop from thunderstorms and sometimes as the result of hurricanes. The weather conditions which tend to generate this phenomenon are unseasonably warm and humid earth surface air, cold air at middle atmospheric levels, and strong upper-level jet stream winds. The instability of weather patterns during the "transitional" Spring and Fall seasons, when warm- and cold-air systems often converge violently, make these particularly dangerous timeframes for tornado activity.

In the first half of this century, the number of tornadoes recorded per year was less than 200. Since 1951, the number has averaged from 900 to 1,000 per year. The increase results from a number of factors not necessarily related to weather changes. Increased population density means that there are more people to detect and report tornadoes which touch down in formerly isolated areas. In addition significant improvements in technology, communications, and military and weather service tracking have improved both the detection and reporting of tornadoes.

Tsunami

Definition	<i>Seismic sea wave activity usually generated by submarine geophysical displacement, such as an earthquake or a volcano.</i>
National Frequency	The yearly national average is 2.75 (based on data during the period 1930 - 1989). The annual frequency is 1.0 for Hawaii.
Regions at Risk	The ocean coastal areas, especially those on the Pacific.
Season(s)	Year round.
Effects	Neither the annual death toll or amount of economic damage has been determined. Tsunamis trigger flooding and landslides.
Worst Event(s)	<p>On April 1, 1946, a tsunami with wave heights of 55 feet above sea level struck Hawaii, killing 173 people and causing property damage estimated at \$26 million. Generated by an earthquake near the Aleutian Islands in Alaska, the tsunami traveled from the Aleutians at about 490 miles per hour, with a wave length of about 100 miles.</p> <p>A tsunami following the Prince Rupert Sound (Alaska) earthquake in 1964 directly impacted the three West Coast States and Alaska, resulting in 122 deaths and damage totaling \$96 million (Hawaii was also affected, but damages were significantly lower). Tsunami-generated waves of 20 feet crashed ashore at Crescent City, California, and waves ranging from 10 - 16 feet occurred along parts of other coastal areas of California, Oregon and Washington.</p>
Discussion	<p>A tsunami (a Japanese word meaning "harbor wave") is a series of waves of extremely long length and "life-span" typically caused by a sudden vertical displacement of a large area of the sea floor during an undersea earthquake or volcano. Although tsunamis are often called tidal waves, they are not caused by the tidal action of the moon and the sun.</p> <p>The waves triggered by an earthquake or volcano travel outward in all directions from the generating area, traveling at speeds of 300 to 600 miles per hour in the deep and open ocean. The distance between successive crests can be as much</p>

as 300 to 400 miles. In deep water, the height of the waves may be no more than one - two feet and may pass a surface vessel unnoticed. However, upon reaching shallower waters around islands or on a continental shelf, the speed of the advancing wave diminishes, its length decreases, and its height increases greatly as a result of the water piling up along the shoreline. The advancing turbulent wave front of a tsunami may crash inland, sweeping all before it, sometimes beaching boats and ships thousands of feet inland. (*A tsunami triggered by the Krakatoa volcano in the Sunda Strait between Java and Sumatra on August 26, 1883, generated a tsunami estimated at 100 feet in height, which caused tremendous loss of life on the islands.*) Successive wave crests, each typically arriving from 10 - 45 minutes later, may continue to pound the coast for several hours. Several days may pass before the sea returns to its normal state.

Most tsunamis are generated in the Pacific. Hawaii and the west coast of the United States have been struck repeatedly by tsunamis generated by earthquakes in South America and the Aleutian-Alaska region. Tsunamis of significant destructive force are relatively infrequent. During the last 60 years, 165 incidents have been recorded in the United States and Pacific Trust Territories.

While tsunamis are generally associated with the Pacific Ocean, they are rare, but not unknown, along the Atlantic coastline. A severe earthquake on November 18, 1929, in the Grand Banks of Newfoundland generated a tsunami that caused considerable damage and loss of life at Placentia Bay, Newfoundland. Small sea waves were recorded along the east coast of the United States as far south as Charleston, South Carolina. In the Caribbean, a large earthquake on November 18, 1867, centered between St. Thomas and St. Croix, caused sea waves more than 20 feet high that swept inland in the Virgin Islands and Puerto Rico. A local tsunami accompanying a magnitude 7.5 earthquake that occurred offshore of northwestern Puerto Rico on October 11, 1918, drowned many persons and destroyed numerous dwellings. (Sources: *Earthquakes, Volcanoes, and Tsunamis — An Anatomy of Hazards*, by Karl V. Steinbrugge. Skandia America Group, 1982. pp. 234-246. and *Earthquakes: A National Problem*, (FEMA), including sources of information from (Schnell, M.L., and Herd, D.G. (eds.), *National Earthquake Hazards Reduction Program*:

Report to the United States Congress U.S. Geological Survey Circular 918, 1984., and The Severity of an Earthquake, U.S. Geological Survey Popular Publication, 1979.)

Volcano

Definition	<i>An eruption from the earth's interior producing lava flows or violent explosions issuing rock, gases, and debris.</i>
National Frequency	Among the known risk areas, volcanic eruptions occur more frequently in Hawaii.
Regions at Risk	The primary areas affected include the Pacific Rim States of Hawaii, Alaska, Washington, Oregon and California. Montana and Wyoming are also at risk, but to a much lesser extent.
Season(s)	Year round.
Effects	Violent volcanic outbursts are characterized by clouds of poisonous gasses, rivers of lava, and volcanic ash that can spread over wide areas. Major eruptions can result in heavy layers of ash covering widespread land areas, as witnessed following the eruption of Mt. St. Helens. Volcanic activity can also trigger tsunamis, landslides, floods (from the damming effects of slides or lava), and fires.
Worst Event	The eruption of Mount St. Helens in southwestern Washington on May 18, 1980, resulted in 60 deaths and caused approximately \$1.5 billion in damage.
Discussion	All of the areas in the United States where volcanic action has occurred in the last 10,000 years are located west of the Rocky Mountains and, as a result, could pose potential future hazard areas (<i>see Figure 14</i>). In addition to the Mount St. Helens event, other recent eruptions have occurred in Alaska's Mount Augustine in 1976 and 1986 and Mount Redoubt in 1989 and continuing in 1990. Hawaii's Kilauea and Mauna Loa have been relatively active in recent years. For the past seven years, Kilauea has posed a continuous threat to the surrounding population, while Mauna Loa, on the same island, has been less active with a major eruption in 1950 and ones of smaller magnitude in 1975 and 1984.

Areas of Potential Volcanic Activity



- EXPLANATION**
- Strato volcanoes of Cascade Range; quiet to explosive eruptions during past 10,000 yrs.
 - (●) Areas of volcanic activity during past 10,000 yrs; primarily lava flows, mudflows, and pyroclastic flows.
 - (■) Area of extremely large and explosive eruption during last 2 million yrs.

Figure 14

About 500 volcanoes have had recorded eruptions within historical times. Most volcanoes occur at the boundaries of the earth's crustal plates, such as the famous "Ring of Fire" that surrounds the Pacific Ocean Plate. Of the world's active volcanoes, about 60 percent are along the perimeter of the Pacific. (Sources: *Earthquakes, Volcanoes, and Tsunamis — An Anatomy of Hazards*, by Karl V. Steinbrugge. Skandia America Group, 1982. pp. 259-274.)

Wildfire

Definition	<i>Any instance of uncontrolled burning in grasslands, brush, or woodlands.</i>
National Frequency	According to U.S. Forest Service figures for the years 1986-1988, the national average is 140,341. The State average is 2,794 with Georgia having the highest average of 12,478.
Regions at Risk	All wooded, brush, and grassy areas—especially those in Kansas, Mississippi, Louisiana, Georgia, Florida, the Carolinas, Tennessee, California, Massachusetts, and the National forests in the western states. <i>Figure 15</i> shows the distribution of wildfires in the States in 1988.

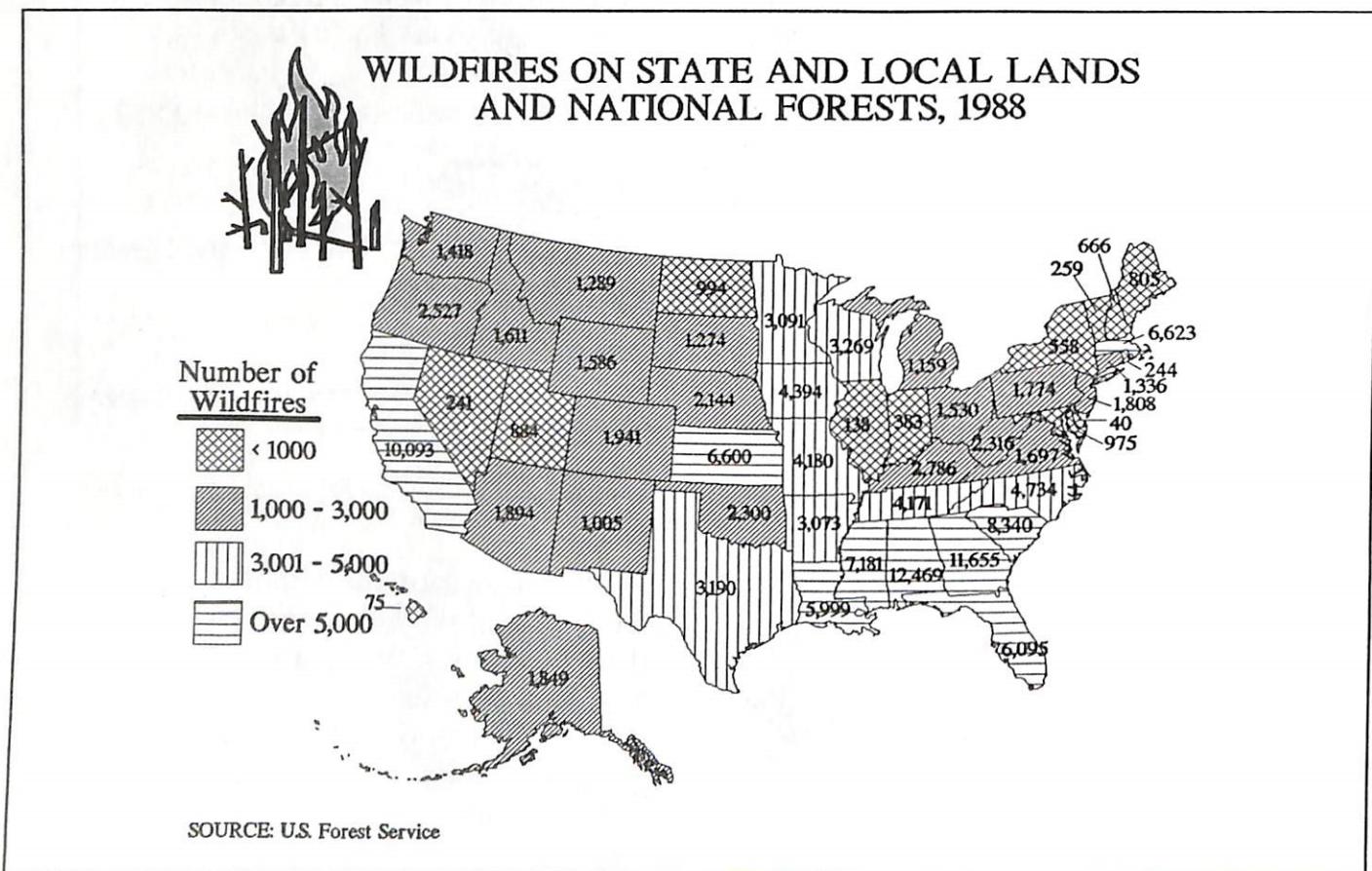


Figure 15

Season(s)	Wildfires occur most often in the Spring, Summer and Fall.
Effects	The annual death and economic damage rates have not been determined. Secondary events of wildfires would be soil erosion and subsequent landslides following heavy rains.
Worst Event	The worst single event in terms of deaths was the 1871 wildfire in Wisconsin where 1,182 people died. The worst single wildfire season in six decades occurred in 1988 with Federal expenditures of \$538 million combating fires in widespread areas of the West, while 6,000 soldiers and marines and nearly 4,000 temporary workers assisted the 20,000 professional firefighters on the line.
Discussion	The 1988 wildfire season resulted in the burning of 2.2 million acres of tundra and spruce forest in Alaska, nearly twice the normal yearly average. In California, 9,832 fires burned 175,714 acres of State land, while 400 private homes, barns and other structures were destroyed. The majority of these damages occurred as the result of a 35,000-acre fire near Sacramento in September 1988 that caused an estimated \$22 million in damage.

Winter Storm (Severe)

Definition	<i>Ice storm, blizzard, and extreme cold. Vulnerable areas would be subject to heavy snowfall, combined snow and high winds, or ice storms.</i>
National Frequency	None has been determined. The winter storm season varies widely depending upon the area's latitude, altitude, and proximity to moderating influences.
Regions at Risk	Almost the entire United States except Hawaii and the Territories are at risk. The level of risk depends on the normal severity of local winter weather. Winter storms known as "northeasters" cause extensive coastal flooding, erosion and property loss in the northeastern and middle Atlantic States.
Season(s)	Winter, although some may occur in the late Fall and early Spring.
Effects	The annual average of snow-related deaths for 1936-1969 was greater than 88. Economic damage has not been determined. In the aftermath of winter storms, the weight of snow can cause structural failures; for example, in 1978 the roof of the Hartford Civic Center in Connecticut collapsed following back-to-back blizzards. The spring thaw of heavy winter snowfalls and river ice jams can cause floods. The estimated damage from melting ice jams that lead to flooding is in excess of \$199 million a year.
Worst Event	The worst event was an 1888 East Coast blizzard when 400 deaths were recorded.
Discussion	Some areas of the country tend to be more susceptible than others to severe winter storms. Generally, the regions where harsh winters are common are more prepared for severe winter weather. Those areas where such weather is rare are more likely to experience disruptions when winter storms impact.



TECHNOLOGICAL/MAN-MADE THREATS

Technological/man-made threats represent a category of events that has expanded dramatically throughout this century with the advancements in modern technology. Like natural threats, they can affect localized or widespread areas, are frequently unpredictable, can result in substantial loss of life (in addition to the potential for damage to property), and can pose a significant threat to the infrastructure of a given area. Technological/man-made threats include: hazardous materials incidents at fixed facilities; hazardous materials incidents resulting from transportation accidents; power failures; radiological incidents at fixed facilities; radiological incidents resulting from transportation accidents; structural fires; and transportation accidents of all types.

Hazardous Materials Incident - Fixed Facility

Definition	<i>Uncontrolled release of hazardous materials from a fixed site.</i>
National Frequency	In 1987, the first year of reporting, 22.5 billion pounds of releases were reported from a total of 19,728 manufacturing facilities which submitted 74,152 individual chemical release reports. Most reports were from the Eastern States, California and Washington State.
Regions at Risk	All areas of the U.S. where hazardous materials facilities exist are at risk to this hazard. Jurisdictions with hazardous materials fabrication, processing, storage sites, hazardous waste treatment storage, or disposal sites are at risk.
Season(s)	Year round.
Effects	The designated chemicals cover a wide range of toxicity and many have minimal or no effects on humans in small doses. Further, release does not necessarily mean there was exposure to humans. No statistics related to exposure injuries or deaths were readily available for purposes of this report.
Worst Event	An incident, which included a release of radioactive material, occurred at the Kerr-McGee plant in Oklahoma in 1986, resulting in one death and the hospitalization of 100 people. In addition, 1,000 people were contaminated in Erwin, Tennessee, at a nuclear fuel plant in 1979.
Discussion	The principal reporting of these incidents falls under the terms of the Emergency Planning and Right to Know Act of 1986 which requires reporting to the Environmental Protection Agency (EPA) releases of 308 specific chemicals in 20 chemical categories. This input serves as the basis for the Toxic Reporting Inventory maintained by the EPA. The different types of releases include: <ul style="list-style-type: none">• Emissions of gases or particles to the air;• Wastewater discharges into rivers and other bodies of water;• Solid waste disposal in on-site landfills;• Injection of wastes into underground wells;

- Transfers of wastewaters to public sewage plants; and
- Transfers of wastes to off-site facilities for treatment or storage.

Hazardous Materials Incident - Transportation

Definition	<i>Uncontrolled release of hazardous materials during transport.</i>
National Frequency	There are an average of 8,568 hazardous materials transportation incidents reported each year in the United States. This has varied from a high of 17,646 in 1979 to a low of 5,758 in 1986.
Regions at Risk	Areas at risk would be along highways, rail lines, pipe lines, rivers, and port areas. Because major highways run through virtually all local jurisdictions, all sections of the country are at risk.
Season(s)	There is no season for these incidents, but since highway-related incidents account for 85% of the total, factors such as weather conditions do influence the patterns of occurrence.
Effects	There are an average of 14 deaths annually attributed to hazardous materials transportation incidents. Annual economic damage is estimated at \$17.1 million (1979-1988).
Worst Event	Definitive data unavailable.
Discussion	There are a variety of Federal and State mechanisms for reporting incidents involving the transportation of hazardous materials. The major source of data related to interstate transportation incidents is the U.S. Department of Transportation. Data from this source for the years 1979 through 1988 is shown in <i>Figure 16</i> and clearly indicates that the great majority of incidents occurred in highway transportation and that such incidents were responsible for the preponderance of resultant deaths and injuries.

HAZARDOUS MATERIAL INCIDENTS BY TRANSPORTATION MODE (TOTALS, 1979 THRU 1988)

MODE OF TRANSPORTATION	NUMBER OF INCIDENTS	ASSOCIATED DEATHS	ASSOCIATED INJURIES
 Air	1,505	0	87
 Highway	73,148	139	2,730
 Railway	9,936	2	924
 Water	158	1	33
 Freight Forwarder	803	0	42
 Other	131	0	23
Totals	85,681	142	3,839

Figure 16

Power Failure

Definition	<i>Interruption or loss of electrical service for an extended period of time. An extended period of time would be long enough to require emergency management organization response to needs for food, water, heating, etc., caused by loss of power.</i>
National Frequency	Definitive data not available.
Effects	A summary of potential effects includes loss of power to hospital and medical care facilities which could cause life-threatening situations for patients; inability to use necessary medical care equipment (in the absence of working backup generators); massive traffic stoppages due to failures of traffic lights; spoilage of food; lack of heating/air conditioning for many residences/businesses; work interruptions since equipment cannot be used; and loss of major databases for business, educational and other institutions.
Worst Event	On November 9, 1965, a power failure in an Ontario plant blacked out parts of eight northeastern States and two provinces of Canada.
Discussion	There are two classes of power failures: failures internal to the power distribution system such as occurred in New England in 1965, and failures as the result of external causes such as severe storms. There is no centralized data source for this type of information and especially for those instances where an emergency response was required.

Radiological Incident - Fixed Facility

Definition	<i>Uncontrolled release of radioactive material at a commercial nuclear power plant or other reactor facility.</i>
Regions at Risk	Areas at risk are normally designated as: (1) within the <i>plume emergency planning zone</i> of such facilities (jurisdictions located within a 10-mile radius of a nuclear power plant); or (2) within the <i>ingestion emergency planning zone</i> (jurisdictions within a 50-mile radius of a nuclear power plant). About 75% of the states are affected, in particular the eastern half of the contiguous 48 States and the west coast states.
Season(s)	Year round.
Effects	An incident could cause the release of radioactive materials into the atmosphere. Three dominant exposure modes to people have been identified: (a) whole body (bone marrow) exposure from external gamma radiation and from ingestion of radioactive material; (b) thyroid exposure from inhalation or ingestion of radioiodines; and (c) exposure of other organs (e.g., lung) from inhalation or ingestion of radioactive materials.
Worst Event	This occurred at the Three Mile Island Nuclear Power Plant in Pennsylvania on March 28, 1979. While there were no deaths as a result of this incident, officials considered the possibility of evacuating 650,000 citizens within a 20-mile radius of the plant which is near Harrisburg.
Discussion	As a result of the incident at Three Mile Island, major changes were instituted in the regulation of the nuclear power industry. FEMA was given the responsibility for review and approval of State and local radiological emergency plans and preparedness for jurisdictions located within the 10-mile radius of a nuclear power plant, the area known as the "plume emergency planning zone" and the 50-mile area known as the "ingestion emergency planning zone". <i>Figure 17</i> shows the location of commercial nuclear reactor sites in the United States as of December 1989. <i>Figure 18</i> depicts events that occurred at nuclear reactor facilities during the period 1985 – 1988.

**COMMERCIAL NUCLEAR REACTOR SITES
IN THE UNITED STATES - DECEMBER 1989**

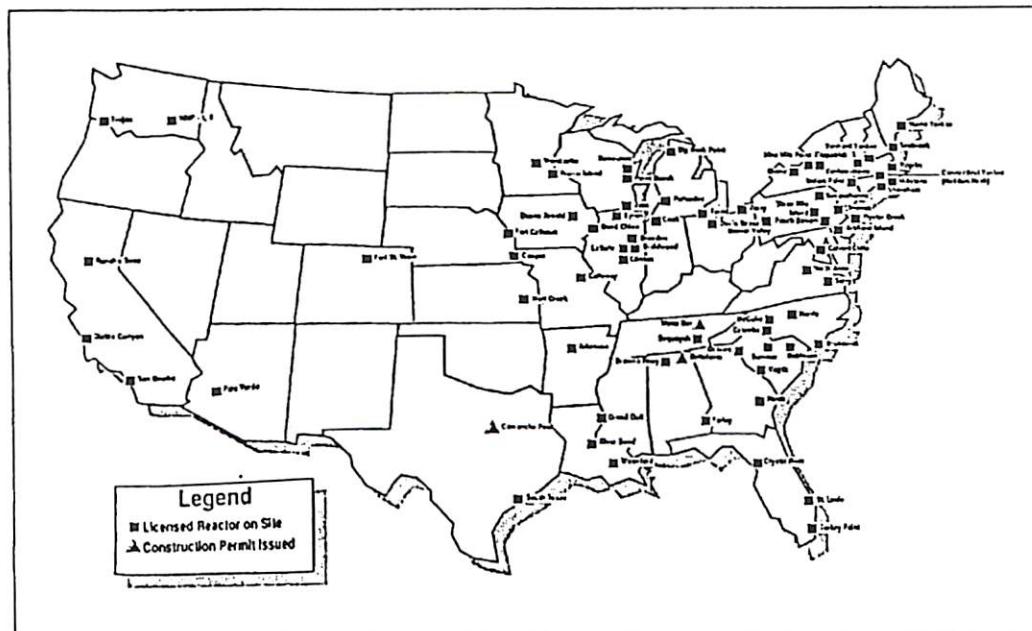


Figure 17

**NUCLEAR REACTOR FACILITY EVENTS
1985-1988**

Class of Event	Year			
	1985	1986	1987	1988
Unusual Event	312	209	231	212
Alert	11	9	9	6
Site Area Emergency	0	0	0	0
General Emergency	0	0	0	0

Figure 18

Radiological Incident - Transportation

Definition

Any incident involving the shipment of radiological materials.

These incidents were subsumed under the general Hazardous Materials – Transportation category previously discussed and are included in the same data base.

Structural Fires

Definition	<i>Uncontrolled burning in residential, commercial, industrial, or other properties in rural or developed areas.</i>
National Frequency	During the period 1983-1987, there were 2,300,000 fires reported in the United States annually.
Regions at Risk	All areas are at risk to personal injury or property damage due to fire.
Season(s)	Year round.
Effects	During 1983-1987, there was an average of 5,800 civilian fire deaths, 29,000 civilian injuries, and \$7.3 billion dollar in losses from fire reported each year.
Worst Event	The largest number of lives lost in an urban structural fire occurred at the Iroquois Theater in Chicago in 1903 where 602 persons died. The “Chicago Fire” of 1871, which killed 230 people, burned 17,450 buildings, and caused damages of \$196 million, ranks as one of the worst urban fires in the country’s history.
Discussion	According to the FEMA United States Fire Administration (USFA), the fire problem in the United States is of major proportions and comparatively, is one of the worst in the world in terms of relative populations. As reported by the United Nations World Health Organization in 1983, for example, the United States, with 27 fire deaths per million persons per year, ranked third of countries for which statistics were available. Only Scotland (32 deaths per million) and Canada (31 deaths per million) ranked higher. Nations reporting the lowest number of deaths included Germany/Spain (each with nine deaths per million), Italy (with seven deaths per million) and Switzerland (with five deaths per million). Fire fatalities tend to be distributed according to population density, i.e., those States with the largest populations tend also to have the greatest number of fire fatalities. For example, in 1983, ten States, which accounted for <i>50 percent</i> of the 6,100 fires reported for that year, reported the following fire-fatalities: New York (516); California (412); Illinois (387);

Texas (358); Pennsylvania (313); Georgia (243); Ohio (225); Michigan (188); North Carolina (188); and Florida (176). (See *Figure 19* for the complete listing of States.)

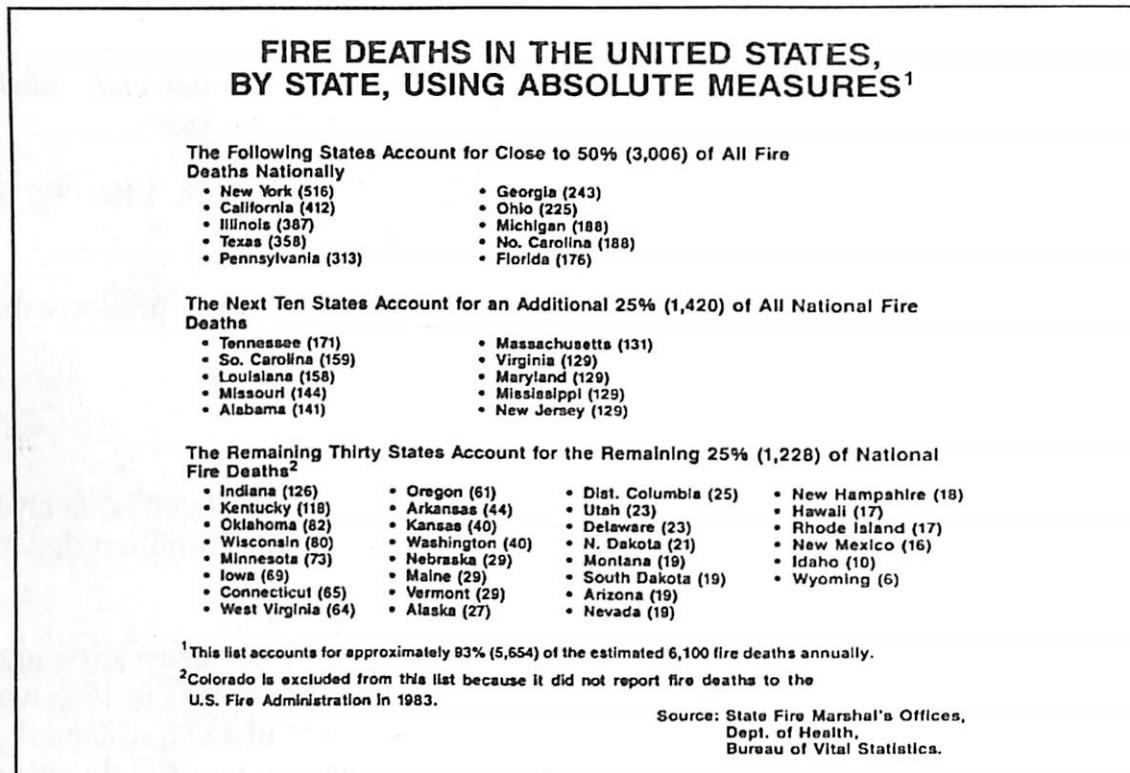
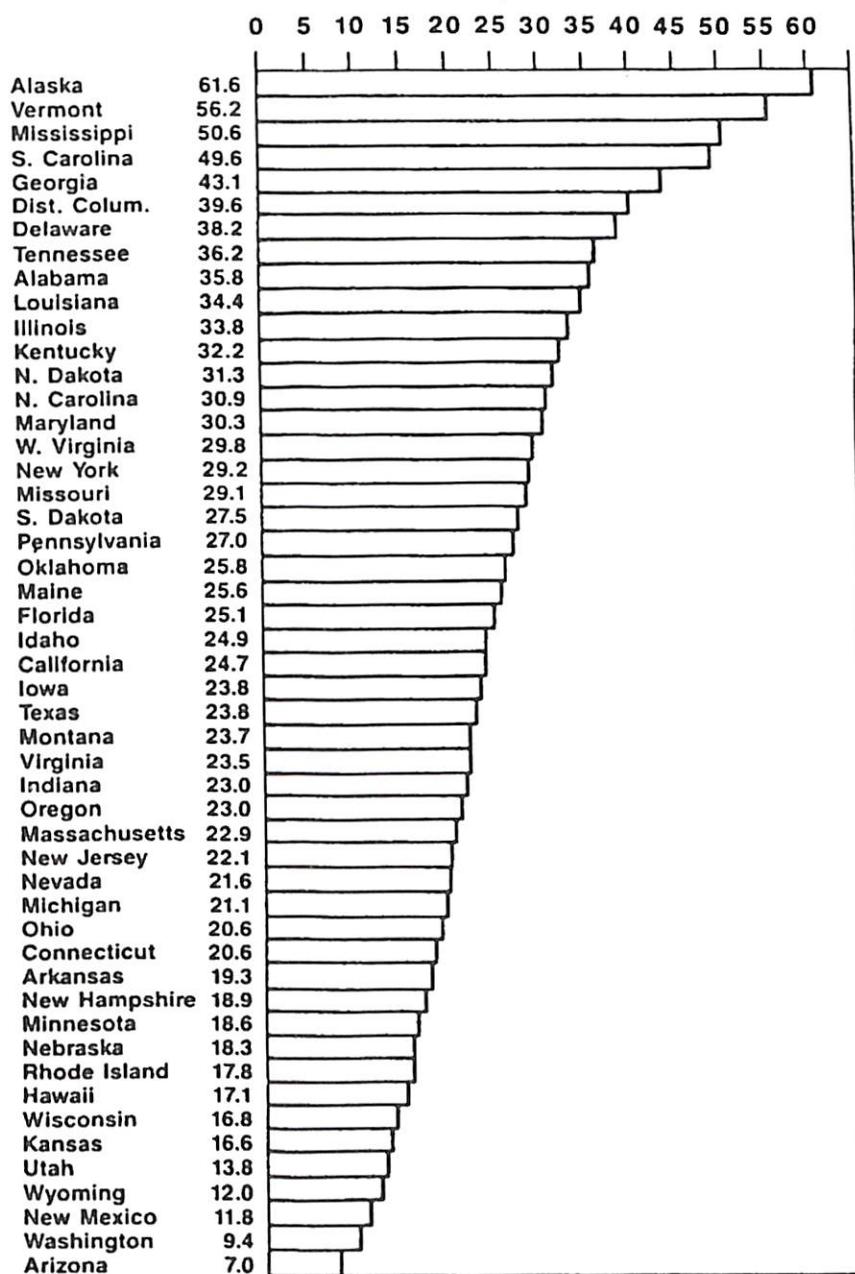


Figure 19

While it is useful to know by State where the greatest number of fire deaths occur, it is perhaps even more useful to know in which States people face the greatest *personal risk* of death by fire. Following is a list of the death rates per million population in rank order for the top 10 States: Alaska (61.6); Vermont (56.2); Mississippi (50.6); South Carolina (49.6); Georgia (43.1); District of Columbia (39.6); Delaware (38.2); Tennessee (36.2); Alabama (35.8); and Louisiana (34.4). It is interesting to note that only Georgia appears on both the list for *highest number of fire deaths* and *highest per capita death rate by fire*. (Source: *Fire in the United States — Deaths, Injuries, Dollar Loss, and Incidents at the National State, and Local Levels in 1983. pp. 26 - 28. Federal Emergency Management Agency, United States Fire Administration.*)

(See *Figure 20* for the complete listing of States.)

DEATH RATES PER MILLION POPULATION, IN RANK ORDER, BY STATE



Source: State Fire Marshal Offices,
U.S. Department of Health and Human Services,
Bureau of Vital Statistics

Note: Colorado data unavailable.

Figure 20

Transportation Accidents

Definition *An incident involving air or rail travel resulting in death or injury.*

National Frequency According to the National Transportation Safety Board, the scheduled airline accident rate per 100,000 departures in 1989 was 0.328, down from 0.412 in 1988. The fatal accident rate, however, rose from 0.027 to 0.109. Statistics on rail accidents in 1989 were not available at the time of this study.

Regions at Risk All areas of the country are at risk to transportation incidents. Risk areas would be around airports with Federal Aviation Administration control towers or with traffic flow heavy enough to pose a hazard, and passenger rail lines. The greatest risk involves those local jurisdictions with airports, rail lines, and major highway systems.

Season(s) Year round.

Effects Effects can include loss of life, associated property losses, and fire.

Worst Event This occurred on May 25, 1979, at Chicago's O'Hare Airport when an American Airlines DC-10 lost its left engine upon take-off and crashed seconds later, killing all 272 persons aboard and three on the ground.

Discussion There are two circumstances in air transport which trigger a disaster response: an airliner crashing in a populated area, such as happened over Cerritos, California, in 1986 as the result of a collision with a private aircraft, and a takeoff or landing accident such as occurred in Washington, D.C., in 1982, and Sioux City, Iowa, in 1989.

Apart from the actual rescue operations, the Washington, D.C., crash highlighted two problems. First, there was a multi-jurisdiction response and a lack of coordination became apparent, even to the extent there were not common radio frequencies for communications. Secondly, while this rescue operation was underway, there was a second fatal accident involving a subway train. This placed an added severe strain on the District of Columbia's disaster response resources.

In terms of loss of life, there have been two serious railroad accidents in the past 20 years. The first was in Chicago in 1972 when one commuter train plowed into the back of another, resulting in 45 deaths and over 200 injured. A saving factor was that it literally occurred in the backyard of a major hospital which had participated in a disaster drill the preceding day. The second occurred in Chase, Maryland in 1987 when a train derailment resulted in the death of 16 persons.

NATIONAL SECURITY THREATS

National security threats represent those threats that are primarily the result of actions of external, hostile forces on the land, population or infrastructure of the United States. The potential for damage resulting from national security threats ranges from the relatively localized damage that could be expected to result from a terrorist attack to the catastrophic devastation that could be expected to occur from either a chemical, biological or nuclear attack on the United States. Like natural or technological/manmade threats, national security threats can be either predictable or unpredictable (for example, a preemptive strike versus an attack following a buildup of tensions). National security threats include: nuclear attack; chemical/biological warfare; civil disorder; and low-intensity conflict (including terrorism, subversion, insurgency and drug trafficking).

Nuclear Attack

Definition	<i>Any hostile action taken against the United States by foreign forces which results in destruction of military and/or civilian targets through use of nuclear weapons. (Blast and fallout effects are assumed from a large-scale nuclear attack.)</i>
National Frequency	No U.S. occurrence.
Regions at Risk	All areas of the U.S. are at risk for direct blast effects or secondary effects.
Season(s)	An attack could occur at any time of the year.
Effects	The effects of a nuclear attack, if one should occur, would be devastating and far reaching. Many millions of lives would be at risk to the effects of blast overpressure, fire and radioactive fallout. The loss of property and infrastructure would be catastrophic with an almost incalculable associated dollar value.
Discussion	As President Bush has stated in <i>The National Security Strategy of the United States</i> , issued in March 1990: <i>Deterrence of a nuclear attack remains the cornerstone of U.S. national security. Regardless of improved U.S. – Soviet relations and potential arms control agreements, the Soviets' physical ability to initiate strategic nuclear warfare against the United States will persist and a crisis or political change in the Soviet Union could occur faster than we could rebuild neglected strategic forces. A START agreement will allow us to adjust how we respond to the requirements of deterrence, but tending to those requirements remains the first priority of our defense strategy.</i> <i>The United States must continue to maintain modern defenses that strengthen deterrence and enhance security. We cannot ignore continuing Soviet efforts to modernize qualitatively even as they cut back quantitatively. As Chairman Gorbachev declared last September 21st, "While reducing expenditure for [defense] purposes, we are paying attention to the qualitative rearmament of the</i>

Army, and in this way we are not permitting the overall level of our defense capability to be weakened in any degree." Our response thus represents prudent caution, but the Soviet leadership and people should realize that it is a caution based on uncertainty, not on hostility.

The areas in the U.S. at high risk from the large-scale nuclear attack threat can be illustrated by the blast overpressure map (*Figure 21*) and the fallout maps (*Figures 22 & 23*). These maps were prepared based on the Nuclear Attack Planning Base (NAPB) National Aimpoint List, a data base of projected Soviet targeting of the U.S. in a preemptive nuclear strike. *Figure 21* illustrates those

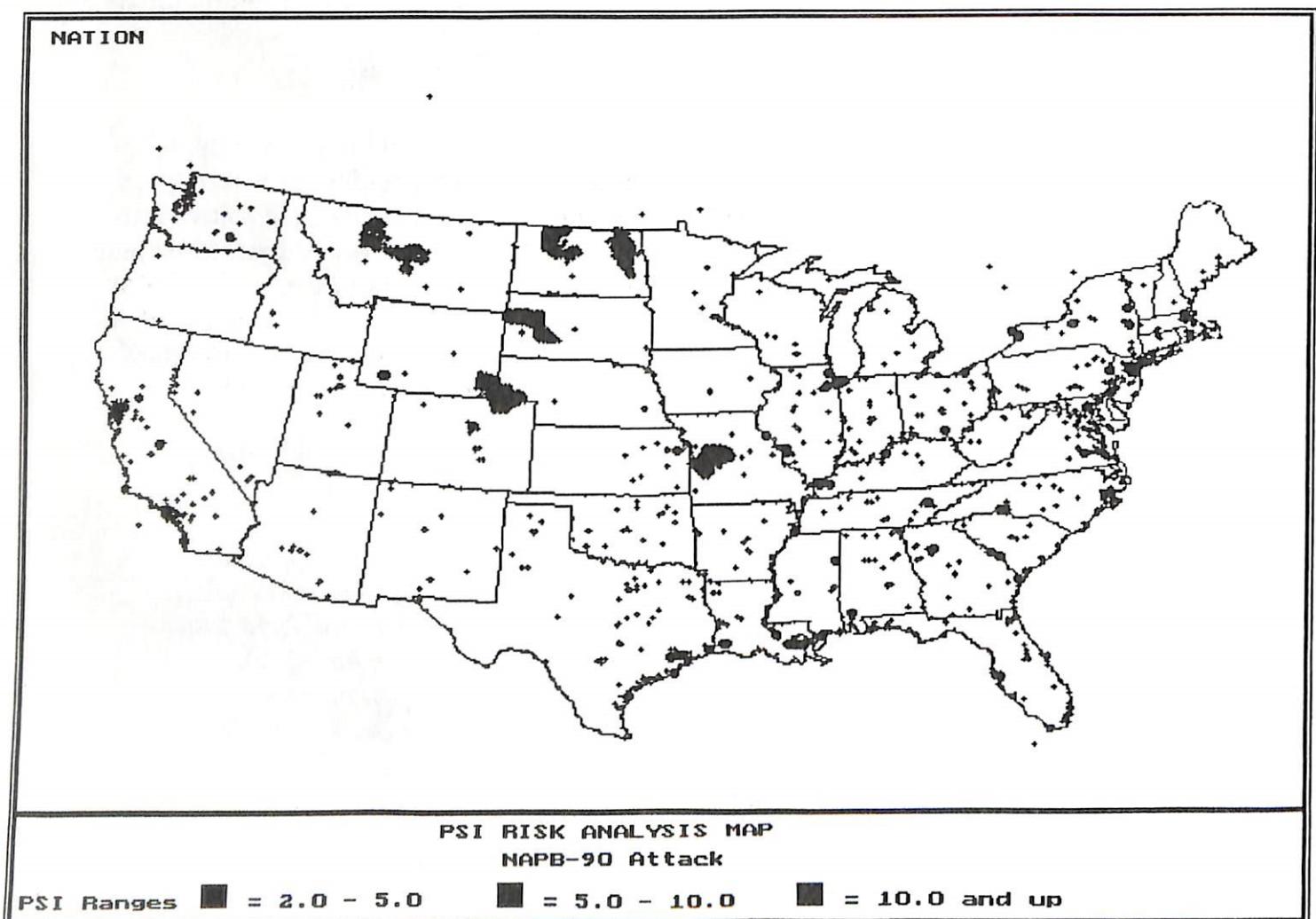


Figure 21

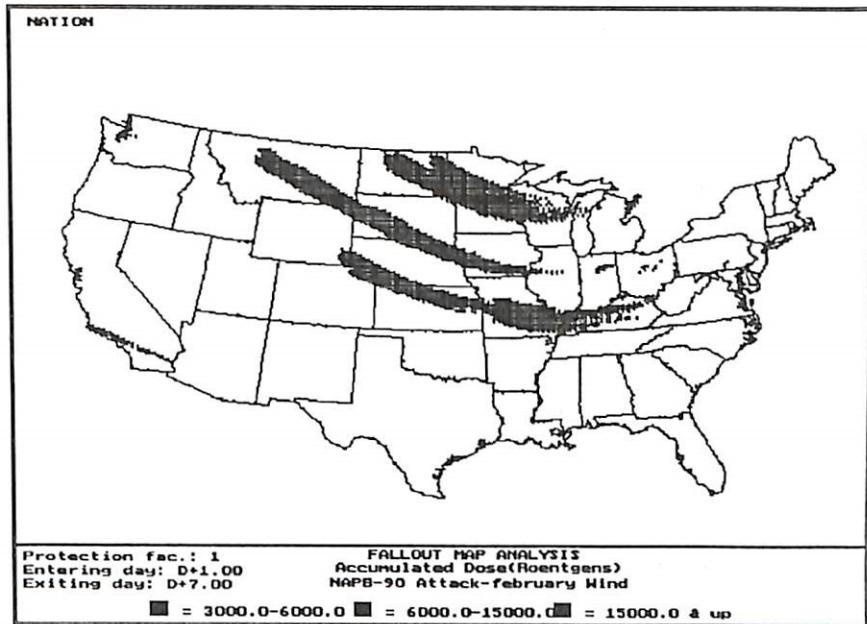


Figure 22

areas in the U.S. which could be at risk from blast overpressure resulting from a large-scale nuclear attack. The fallout maps shown in *Figures 22 & 23* illustrate radiation high risk areas, based upon a typical wind pattern from the months of February and May. If the fallout levels that are depicted on these two charts should actually occur, death or debilitating illness from radiation is certain for resident populations without adequate shelter. In addition, these charts show that **exact** radiation levels can never be deter-

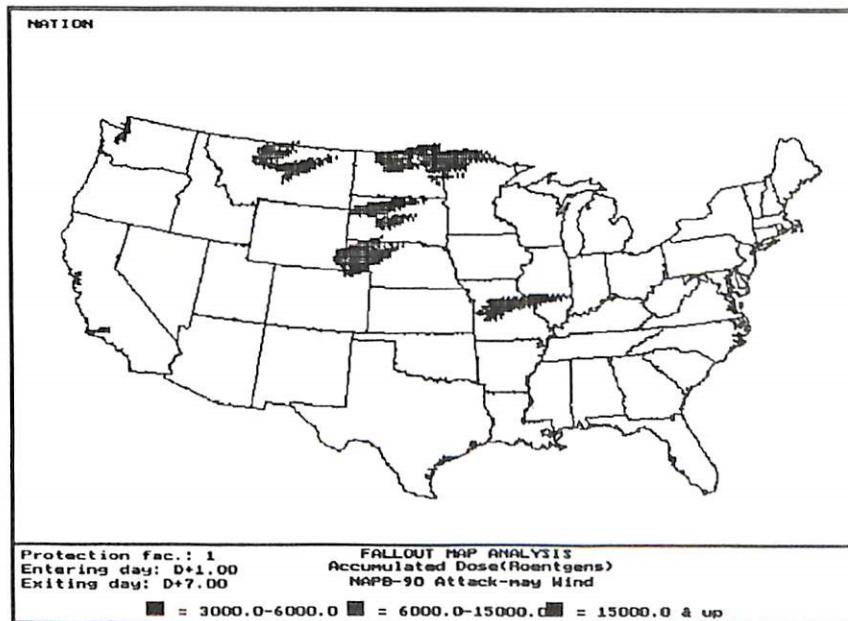


Figure 23

mined in advance of fallout arrival. Hence, a minimum fallout protection level for an entire area cannot (and should not) be defined. It should also be noted that other areas are also at risk at lower, but still harmful levels. Other wind patterns throughout a year would, of course, result in some variation of the fallout threat, but the fallout high risk areas are predominately east of the missile fields.

Of additional concern to the United States is the increasing proliferation of missile capability worldwide, a capability that could be made more lethal by the addition of chemical, biological or nuclear warheads. Apart from the *United States, the United Kingdom, France, the USSR and China*, there are thought to be at least 17 additional countries that are either nearing nuclear capability on their own or are considered capable of obtaining nuclear warheads or missiles from illegal sources. These include: Argentina, Brazil, Egypt, India, Iran, Iraq, Israel, Libya, Pakistan, North Korea, North Yemen, Saudi Arabia, South Africa, South Korea, South Yemen, Syria and Taiwan (*see Figure 24*).

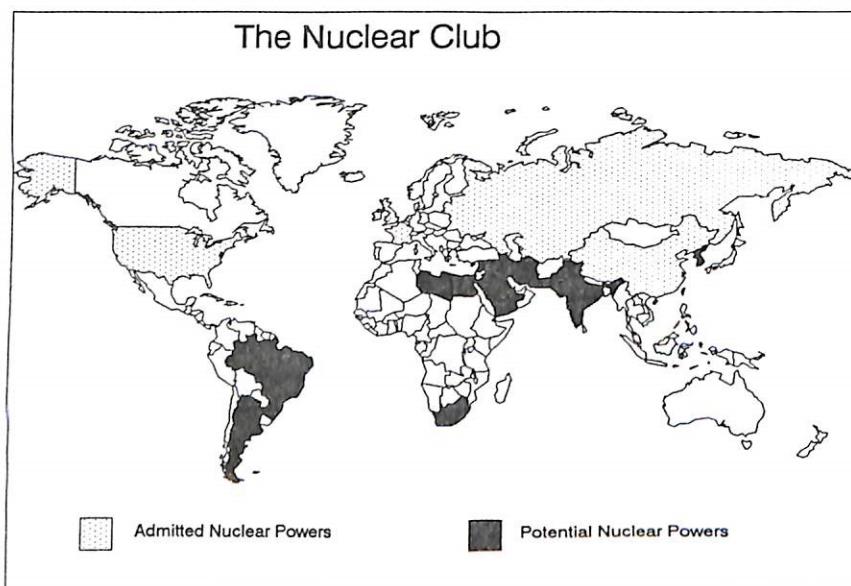


Figure 24

As noted by the President in the March 1990 *National Security Strategy of the United States*:

The spread of evermore sophisticated weaponry — including chemical, biological, and nuclear weapons — and of the missiles capable of carrying them represents a growing danger to international security. This prolifera-

tion exacerbates and fuels regional tensions and complicates U.S. defense planning. It poses ever greater dangers to U.S. forces and facilities abroad, and possibly even to the United States itself.

Chemical and Biological Warfare

Definition	<i>The introduction of toxic or infective agents to harm an enemy's population, animal or plant food resources.</i>
National Frequency	No U.S. occurrence, however, with the continued development of chemical/biological weapons and improved delivery systems by Third World nations, the threat is increasing.
Regions at Risk	Nationwide
Season(s)	An incident could occur at any time of the year.
Effects	<p>The effects of chemical warfare would be devastating to human and animal life or, depending on the agent used, plant life as well. Chemical weapons, including warheads on missiles, contain liquid or gaseous chemical agents that cause toxic damage to living tissue rather than damage resulting from other physical effects such as blast, heat, or shrapnel. Although chemical agents do little damage to buildings or vehicles, long-lasting chemical agents can be placed in structures or whole areas, thereby rendering these locations useless for humans or animals.</p> <p>Four general types of chemical agents are available for use as weapons which can cause serious injury or death through inhalation and/or body surface contact. These are: (1) blister agents — general tissue irritants such as mustard gas that can burn or blister the skin or lung tissue if inhaled; (2) blood gases — agents such as hydrogen cyanide that interfere with cell respiration after entering the blood circulation through the lungs; (3) lung irritants — choking agents such as phosgene that irritate and damage lung tissue; and (4) nerve agents — chemicals such as tabun, sarin, and soman that interfere with the transmission of nerve impulses and disrupt vital bodily functions such as breathing. (Source: <i>The Problem of Chemical and Biological Warfare. Vol. II, CB Weapons Today, Stockholm International Peace Research Institute (SIPRI), 1973. p. 36 [as used in a Congressional Research Service report entitled, Missile Proliferation: Survey of Emerging Missile Forces, October 3, 1988]</i>).</p> <p>Biological weapons contain living organisms that can cause disease or death; however, the success or effectiveness of a biological agent is directly related to its ability to reproduce in the organism</p>

attacked. The introduction of a biological agent into a city's water supply has the potential, for example, to kill the entire population of the city.

The lethal potential of these weapons has been increased recently by advances made in genetic engineering and biotechnology. Normally harmless, non-disease producing microorganisms can now be modified to become highly toxic or to produce diseases for which an opponent has no known treatment or vaccine. In other cases, disease agents which have been considered too unstable for storage or warfare applications can now be modified using genetic engineering in order for them to be used as biological agents for warfare. (Source: *Soviet Biological Warfare Threat*. Defense Intelligence Agency, DST-1610F-057-86, 1986. p.12, (Unclassified). (As used in a Congressional Research Service report entitled, *Missile Proliferation: Survey of Emerging Missile Forces*, October 3, 1988).

Discussion

There is renewed concern regarding the proliferation and use of chemical and biological agents in warfare, in spite of the 1924 Geneva Accord banning their use. In 1970 when the United States halted the production of chemical agents, its estimated stockpile was 36,000 tons, compared with a stockpile of 360,000+ tons maintained by the Soviets alone. Concern regarding biological and chemical warfare has been heightened by their use in Afghanistan and Southeast Asia and during the prolonged hostilities between Iraq and Iran.

A major problem with these threats is that the agents require little sophistication and are much cheaper to manufacture than nuclear weapons. The technology and expertise required to produce chemical warfare agents are very similar to those common in the petrochemical, pharmaceutical, fertilizer and insecticide industries. The chemicals would likely be made in newly dedicated production units since new construction is easier than conversion of existing factories. These facilities can be built and operated to produce large quantities of the agents from widely available chemical compounds using relatively simple processing techniques. Any country with a modest amount of technical expertise that produces and refines petroleum could make mustard gas, for example, without importing any chemicals. Conversely, the production of nerve gas would require a greater challenge because of the requirement for large quantities of raw materials. (Source: *Congressional Research Service report entitled, Missile Proliferation: Survey of Emerging Missile Forces*, October 3, 1988. p. CRS-33.).

The potential for terrorist use is high. For example, a 1971 raid on a German terrorist group at a Paris laboratory, uncovered numerous documents for manufacturing bacterial cultures.

Libya is known to be developing toxins and Syria is producing nerve gas. Syria's missile delivery capability puts a new dimension on the Arab-Israeli conflict. With continuing advancements in missile capability, these weapons could easily be turned against the U.S. There is also the possibility that the missiles and warheads could be brought into this country virtually undetected.

Use of chemical or biological agents under conditions of war does not necessarily imply all-out use. Rather, limited use could be made in order to disrupt or undermine political order while preserving the industrial base of a country being attacked.

Civil Disorder

Definition	<i>Any incident, the intent of which is to disrupt a community to the degree that police intervention is required to maintain public safety. Terrorist attacks, riots, strikes resulting in violence and demonstrations resulting in police intervention and arrests are included in this category.</i>
National Frequency	Undetermined
Regions at Risk	Nationwide
Season(s)	Civil disorders may occur at any time but are more frequent during the summer months.
Effects	The effects of this threat can be varied based upon the type of event and its severity and range. Loss of life and property as well as disruptions in services such as electricity, water supply, public transportation, communications, etc., could result from civil disorder. Certain types of facilities are more vulnerable than others during civil disorders. These include Federal, State and local government buildings, universities, military bases, nuclear power facilities and correctional facilities.
Discussion	For the most part, we are in a period of quiescence with respect to riots and violent demonstrations. However, related to the issue discussed under nuclear attack, there are hostile governments bent on violent actions against the United States.

Low-Intensity Conflict

Definition	<i>Low-intensity conflict involves the struggle of competing principles and ideologies below the level of conventional war, e.g., terrorism, subversion, insurgency and drug trafficking (As defined in the President's National Security Strategy of the United States (March 1990).)</i>
National Frequency	Between 1981 and 1986, approximately 24 terrorist events were identified annually. This does not include, however, figures on either <i>subversion, insurgency or drug trafficking</i> since only incomplete data was available.
Regions at Risk	Nationwide, although experience with geographical areas experiencing the largest number of terrorist events during the period 1981 — 1986 shows the northeastern and southern States and Puerto Rico as the areas of highest risk.
Season(s)	Low-intensity conflict can occur at any time of the year.
Effects	The effects of the threats posed by low-intensity conflict can vary significantly in relationship to the size and scale of the event and its associated severity. At a minimum, disruptions resulting from low-intensity conflict can include property damage, disruptions in services such as electricity, water supply, public transportation, communications, etc., and loss of life.
Discussion	To date, low-intensity conflict involving terrorism has been targeted primarily against American interests abroad. However, according to U.S. Army reports, during the period 1981 — 1986, there were 144 incidents which were identified as being terrorist in nature in the Continental United States and Puerto Rico. Of these, 60 were in the Northeast, 36 in Puerto Rico, 29 in the Southern U.S. Region, 14 in the Western States and 5 in the Northern States. Since 1968, there have been 32 attacks directed against Department of Defense facilities. As noted by President Bush in his <i>National Security Strategy of the United States (March 1990)</i> :

It is not possible to prevent or deter conflict at the lower end of the conflict spectrum in the same way or to the same degree as at the higher. American forces therefore must be capable of dealing effectively with the full range of threats, including insurgency and terrorism.

With regard to drug trafficking, President Bush also noted in the same report that:

The Department of Defense...has an important role to play in our National Drug Control Strategy in coordination with the Department of State and law enforcement agencies. The first line of defense against the illegal flow of drugs is at the source — in those countries where illicit drugs are produced and processed before being sent to the United States and other countries....Security assistance also provides host countries with the resources needed to confront the insurgency threats that often are endemic to narcotics-producing regions.

RANKING OF THE THREATS

In its direction to FEMA, the Committee stated that it "...understands that certain natural and manmade disasters threaten communities with a varying degree of severity and frequency..." and specifically requested that the study, "...rank the principal threats to the population according to region and any other factors deemed appropriate." However, it is important to note that any ranking of the threats to communities and emergency management coordinators is potentially misleading because of: (1) the wide variations that can occur with the application of different criteria to the same threat; (2) the significant differences that can occur from the impact of a particular threat on a region and the individual States within that region; (3) the fact that threats in one region are not necessarily applicable to another region; (4) variances in the types of data collected on each threat; and (5) the lack of available data in some cases with which to develop a reasoned ranking.

This is perhaps best typified in the application of criteria which must be used in order to develop the rankings. Threats can be ranked by some or all of the following criteria:

- the potential critical danger of a particular threat which may occur only infrequently;
- average annual frequency of occurrences;
- average annual economic loss;
- average annual loss of life;
- average annual number of incidents requiring Presidential declarations of major disasters/emergencies;
- average annual number of local jurisdictions reporting threats and ranking them;
- the seasonal occurrence of disaster incidents;
- differences in the potential impact of threats on urbanized vs. remote, sparsely populated areas; and
- worst-case deaths by disaster type.

Figure 25 depicts the difficulties in obtaining a clear ranking of threats just in relationship to the various criteria used.

EXAMPLES OF THREAT RANKINGS BY VARIOUS CRITERIA

	RANKING	STATE RANKINGS	AVERAGE DEATHS	WORST CASE DEATHS	AVERAGE ECONOMIC LOSS	ESTIMATED CATASTROPHIC LOSS
First	Flood	FIRE	HURRICANE	Landslide	Nuclear War	
Second	Dam Failure	Flood	Flood	Flood	Conventional War	
Third	Structural Fire	Tornado	Wildfire	Tornado	Chem./Bio. Warfare	
Fourth	Nuclear War	Winter Storm	Earthquake	Hazmat Highway		
Fifth	Industrial Hazards	Landslide	Tornado	Subsidence		
Sixth	Tornado	HURRICANE	Structural Fire	Hazmat Rail		

NOTE: This figure is a partial representation of the variations in threat rankings that can occur from the application of different ranking criteria or perceptions to threats.

Figure 25

During cyclical data collection conducted by FEMA, local emergency managers themselves identify threats with which they are concerned. The information is based on (1) the fact that the jurisdiction has been previously affected by the impact of the particular threat or (2) the possibility that the jurisdiction **could** be impacted by the threat.

As is shown in *Figure 26*, the top ranked threats reported by all States and Territories are *floods, power failures and transportation accidents involving hazardous materials*. The second ranked threats include *wildfires, winter storms, dam failures and hazardous materials accidents at fixed facilities* (with the District of Columbia and all States but Hawaii and most of the Territories reporting).

HAZARDS EXPECTED BY ONE OR MORE JURISDICTIONS IN A STATE/TERRITORY

STATE OR TERRITORY	HAZARDS																					
	Nuclear Attack	Chem/Biol Attack	Civil Disorder	Terrorism	Avalanche	Drought	Earthquake	Floods	Hurricane/T.S.	Landslides	Subsidence	Tornado	Tsunami	Volcano	Wild Fire	Winter Storm	Dam Failure	Haz. Mat. - FF	Power Failure	Radiological - FF	Radiological - Trans.	Transportation
Alabama	●	●	●	●																		
Alaska	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Arizona	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Arkansas	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
California	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Colorado	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Connecticut	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Delaware	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
District of Columbia	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Florida	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Georgia	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hawaii	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Idaho	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Illinois	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Indiana	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Iowa	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Kansas	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Kentucky	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Louisiana	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Maine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Maryland	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Massachusetts	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Michigan	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Minnesota	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Mississippi	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Missouri	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Montana	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Nebraska	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Nevada	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Hampshire	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Jersey	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Mexico	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New York	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
North Carolina	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
North Dakota	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ohio	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Oklahoma	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Oregon	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pennsylvania	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Rhode Island	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
South Carolina	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
South Dakota	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Tennessee	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Texas	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Utah	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Vermont	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Virginia	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Washington	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
West Virginia	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Wisconsin	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Wyoming	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
American Samoa																						
Guam	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Northern Mariana Islands																						
Puerto Rico	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Figure 26

The third ranking includes *transportation accidents* (air, rail, etc., but not including transportation accidents involving hazardous materials), and *urban fires* (this includes structural fires). *Nuclear attack* is listed as the fourth ranked threat by all 50 States and the District of Columbia; however, none of the four Territories reporting listed nuclear attack as a threat. Fifth ranked threats include *drought and fixed facility hazardous materials incidents*. *Tornadoes* rank sixth based on these reports.

If, on the other hand, the ranking was to be based on the average annual number of deaths alone, the rankings would change dramatically. Even though the data on deaths is relatively incomplete (data is only available on one-third of the hazards on an annual basis and one-half on a worst case basis), the top six threats based on the average annual number of deaths would be: (1) *floods, with 163 deaths*; (2) *tornadoes, with 98 deaths*; (3) *winter storms at 88 deaths*; (4) *landslides, showing 25-50 deaths*; (5) *hurricanes with 33 deaths*; and (6) *transportation accidents involving hazardous materials at 14 deaths*. Floods remain first ranked in both listings, while tornadoes, fifth in the previous ranking are second in this ranking. Landslides and hurricanes, not even ranked in the local emergency managers listings, are fourth and fifth respectively. Wildfires are not even listed.

The difference is even more dramatic when compared to a ranking based on the **worst-case deaths**. Based on this data, the rankings would be as follows: (1) *hurricanes – 6,000 deaths from the Galveston, Texas, hurricane in 1900*; (2) *floods – 2,209 deaths from the Johnstown, Pennsylvania, flood in 1889*; (3) *wildfires – 1,182 deaths from a wildfire in Wisconsin in 1871*; (4) *earthquakes – 700 deaths from the San Francisco, California, earthquake in 1906*; (5) *tornadoes – with 689 deaths in 1925*; and (6) *urban fire – 602 deaths from the Iroquois Theater fire in Chicago, Illinois in 1903*. Winter storms, landslides, and highway hazardous material incidents, which rank third, fourth and sixth in relationship to the annual average number of deaths are not even ranked in relationship to the worst-case death data.

Based on a ranking of Presidential disaster declarations from January 1967 through January 1990, *severe storms and flooding* (390 declarations), would rank first; *tornadoes and storms and flooding* (93 declarations) would rank second; *hurricanes and typhoons* (66 declarations) would rank third; *tornadoes* (25 declarations) would rank fourth; *snow and ice* (19 declarations) would rank fifth; and *fires* (13 declarations) would rank sixth. (See Figure 27).

PRESIDENTIAL DISASTER DECLARATIONS JANUARY 1967 THROUGH JANUARY 1990

HAZARD	NO. OF OCCURRENCES
SEVERE STORMS & FLOODING	390
TORNADOES & STORMS & FLOODING	93
HURRICANES & TYPHOONS	66
TORNADOES	25
SNOW & ICE	19
FIREs	13
LEVEE OR DAM FAILURE	8
EARTHQUAKE VOLCANO	7
OTHER	3
 TOTAL	 630

Figure 27

And finally, if rankings are prepared on the basis of economic loss alone, the list changes yet again. Based on available figures on the average annual losses from various incidents, the rankings are as follows: (1) *landslide*—\$1-2 billion; (2) *floods*—\$344 million; (3) *tornadoes*—\$50-\$500 million; (4) *highway hazardous materials incidents*—\$17.1 million; (5) *subsidence*—in excess of \$10 million; and (6) *railway hazardous materials incidents*—\$4.6 million.

While local emergency managers reporting actual or potential threats to FEMA listed nuclear attack as the fourth highest of the threats, none of the local emergency managers listed either of the potential threats posed by chemical or biological warfare or low intensity conflict. Part of this is attributable to the fact that this nation has fortunately been spared the effects of such events so that there is no relevant data on which to base a ranking. These facts do not, however, lessen the very real threat posed by such events and the fact that, by any standard, they could be ranked at the top of any list of threats because of the tremendous devastation, loss of life and economic impact that could be expected to result from a chemical or biological attack on this country or, depending on its severity and magnitude, a low intensity conflict.

Based on an analysis of frequency of occurrence, *fire* ranks as the number one threat facing the American population today, a fact applicable to all regions of the country. As noted earlier, during the years 1983 — 1987, there were 2,300,000 fires reported in the United States which resulted in an average of *5,800 civilian fire deaths, 29,000 civilian injuries, and \$7.3 billion in losses from fire reported each year.*

Earthquakes are a particularly serious threat. While mitigation measures such as building codes can be implemented to reduce the potential damage from an earthquake, preparedness measures in general are particularly difficult as a result of the lack of warning prior to an occurrence. In terms of the potential for significant loss of life and damages totaling in the billions of dollars (particularly in urbanized areas), major earthquakes pose a serious threat to the population in risk areas — they pose a particularly serious threat to the high-risk areas of California and associated risk areas in the western United States.

While all regions of the country are vulnerable to tornadoes, southern and midwestern States are particularly susceptible. During the period 1953 — 1987, a staggering 11,599 tornadoes struck the southern region, including the States of North Carolina, South Carolina, Georgia, Alabama, Florida, Tennessee, Arkansas, Louisiana, Mississippi, Oklahoma and Texas. During the same period, 10,525 tornadoes struck the Midwestern region, comprised of the States of North Dakota, South Dakota, Nebraska, Iowa, Missouri, Kansas, Illinois, Indiana, Wisconsin, Minnesota, Michigan, Ohio, and Kentucky. During the same period, 1,289 tornadoes struck the southwestern States, including California, 1,232 affected the northeastern and mid-Atlantic States, and 608 occurred in the upper northwestern States. While many tornadoes hit sparsely populated, rural areas, they are, nevertheless a serious threat to the southern and midwestern States and responsible on an annual basis for the loss of scores of lives and millions of dollars in property damage.

Hurricanes and tropical storms are also of particular concern to all southern and eastern coastal States from Texas to Maine. During the period 1871 — 1980, 159 hurricanes and tropical storms hit the coastal areas from North Carolina to Texas; while 29 hurricanes and tropical storms affected the coastal region stretching from Virginia to Maine. Nearly 13,000 people have lost their lives in hur-

ricanes from Texas to the northeast during the period 1900 — 1982. Property losses from major hurricanes during the period from 1900 — 1989 exceeded *\$43 billion*.

The long-term effects of major hurricanes, like those resulting from earthquakes, are particularly serious. The high winds triggered by hurricanes can result in massive timber losses. Massive storm surges resulting from the forces of the cyclonic winds on the ocean below can substantially change the geography of a severely hit coastal area. In addition, hurricanes are classic examples of the types of disasters that can trigger “secondary effects” such as tornadoes and flooding which, together with storm surges, can trigger enormous damage. Because of the frequently erratic paths of hurricanes, inland States from Oklahoma on a northeastward path to Ohio, Pennsylvania, New York, and the New England States can sustain significant damage from the downgraded remnants of hurricanes.

The average annual figure for economic damage from floods, derived from losses during the years 1925 — 1973, is *\$344 million*. Perhaps the most pervasive of the natural hazards, floods represent another primary threat affecting all regions of the country to varying degrees. The Upper Northwest, including Washington, Oregon, Alaska, Idaho, Montana, and Wyoming has the lowest percentage of flood-prone areas, totaling 0 — 5 percent of the total land area of these States. The midwestern region, comprised of the States of North Dakota, South Dakota, Nebraska, Iowa, Missouri, Kansas, Illinois, Indiana, Wisconsin, Minnesota, Michigan, Ohio, and Kentucky, has 0 — 20 percent of its total land area prone to flooding. The same ratio, 0 — 20 percent, applies to the western region, which includes the States of California, Nevada, Arizona, Utah, Colorado, New Mexico, and Hawaii.

As is the case with hurricanes/tropical storms, and tornadoes, the States in the southern region (North Carolina, South Carolina, Georgia, Alabama, Florida, Tennessee, Arkansas, Louisiana, Mississippi, Oklahoma and Texas) have the highest percentage of flood-prone land areas, a total of 0 — 30 percent.

Fires, earthquakes, tornadoes, hurricanes, and floods represent the primary threats facing communities and emergency management coordinators. This by no means diminishes the magnitude of the many other threats discussed in this report but reflects, instead, the five most significant annual events threatening the U.S. population and infrastructure. To varying degrees, these are often disasters of major proportions, disasters which can result in major los-

ses of life and property covering hundreds of thousands of square miles of the United States. Their impact, both on the geography of the country and the affected population, is frequently long-term and response and recovery from these disasters can take many years.

THE RELATIONSHIP OF FEMA PROGRAMS TO THREATS

Emergency management is inclusive of all emergencies and is not an “either/or”; it is not “natural disaster” planning versus “technological disaster” planning versus “nuclear attack planning”. Each State and local government should have the operational capability to survive a catastrophic emergency, including attack, and to manage and conduct essential emergency functions. This survivable crisis management capability includes the ability to direct, control, manage and coordinate emergency operations within jurisdictions in cooperation with other State and local governments and the Federal government. To accomplish this requires an integrated in-place capability built on people, communications and hardware, systems, plans and the capability to prepare for and respond to all emergencies, including nuclear attack.

Robert H. Morris

Acting Director, FEMA

Agency Mission

FEMA is responsible for ensuring the establishment and development of policies and programs for emergency management at the Federal, State and local levels. This includes the development of a national capability to mitigate against, prepare for, respond to and recover from the full range of emergencies, including natural and technological disasters and national security emergencies, including nuclear attack.

In view of the broad range of threats facing the population and industry of the United States, FEMA is also responsible for ensuring that plans are in place as part of an integrated, all-hazard emergency management program. While the nature of some emergencies (e.g., earthquakes, hurricanes, tornadoes, radiological emergencies, etc.) does require certain hazard-specific procedures and activities, the goal of the Agency is to ensure the establishment of an integrated, all-hazards emergency management capability.

The Agency has a wide range of programs available to provide financial and technical assistance to State and local governments. The purpose of these programs is to assist State and local emergency managers in coordinating the mitigation, preparedness, response and recovery activities of their governments against the numerous threats facing their communities.

The State and Local Programs and Support Directorate

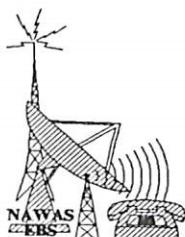
The State and Local Programs and Support Directorate is responsible for the development and maintenance of an effective emergency management and response capability designed to mitigate against and reduce the effects of civil emergencies upon life and property. The Directorate is responsible for developing and overseeing programs to enhance the capability of the State and local governments to prepare for, respond to and recover from emergencies. This responsibility includes preparedness planning and mitigation activities for earthquakes, dam safety, hurricanes, floods (except for those programs authorized by the National Flood Insurance Act of 1968, as amended, which are the responsibility of the FEMA Federal Insurance Administration), tornadoes, and radiological, hazardous material and national security emergencies, including nuclear attack.

The Civil Defense Program

In accordance with the Federal Civil Defense Act of 1950, as amended, the civil defense program provides the basic elements to build an emergency management capability at the State and local levels — an infrastructure of personnel, hardware, facilities, communications and systems that will provide State and local governments with survivable, integrated, all-hazard emergency management capability. As stated in Section 2 of the Civil Defense Act:

It is the policy and intent of Congress to provide a system of civil defense for the protection of life and property in the United States from attack and natural disasters.

Congress has been clear in its support for attack-related preparedness but has authorized the “dual-use” of civil defense funds for preparing for and providing response to natural disasters. The authority to do so is limited only to the extent that such use “...is consistent with, contributes to, and does not detract from attack-related civil defense preparedness”.



The civil defense program provides funding for up to 50 percent of the salaries of State and local emergency managers and fully funds population protection planners and facility surveyors in each State. The preparedness planning undertaken by these individuals has application to both natural and technological disasters, as well as to nuclear attack.

Although the radiological defense program is primarily geared to providing equipment for determining radiation levels following a nuclear attack, the same equipment is available for use in peacetime radiological emergencies.

State Emergency Operating Centers, for which 50 percent of the funding is provided through the civil defense program, are focal points for coordinated State-level disaster response activities throughout the Nation and are the foundation of the developing survivable crisis management system. In addition, the lessons learned from their use in natural disasters allows State and local governments to be better prepared in the event of attack, including nuclear attack.

Listed below are some examples of how the civil defense program is used for specific disasters:

- Through the National Warning System, over 7,000 warnings and tests were issued in 1989 alone.
- The Emergency Broadcast System (EBS) was developed in the civil defense program as a means of providing the President with a means of talking to the general population during times of national emergency, yet Governors and mayors use it nearly 1,000 times a year in response to natural and technological emergencies.
- Evacuations undertaken in natural disasters serve as excellent models for attack planners in determining methods of protecting the population.
- The lessons learned in Emergency Operating Centers during natural disaster response operations are invaluable in determining the possible problems that could be encountered in an attack.
- Plans developed by Emergency Management Assistance planners funded under the civil defense program at the State and local levels are frequently implemented during

disasters. Lessons learned by implementing these plans are of great importance in developing subsequent planning guidance and evaluations.

- Civil defense-sponsored testing/exercising proved invaluable to Sioux City, Iowa, by making possible that city's rapid response to the tragic plane crash that occurred in 1989. As Bev Costello, the Iowa State Training Manager noted in an October 1989 letter to the Superintendent of the FEMA Emergency Management Institute, "The direct impact of the FEMA exercise requirements is that we were very well prepared to respond [to the airline crash] and, in fact, responded accordingly because most of the responders had experience working together...*I found it interesting that the considerations not rehearsed were precisely the areas where problems arose.*" (emphasis added)

The civil defense program reduces the vulnerability of the American people, not just to attack, but to the full range of hazards they face. Combined with the other emergency management programs of the Agency, it is an integral component of and provides the basic infrastructure for a State and local emergency management capability.

Natural and Technological Hazards Programs



FEMA's natural and technological hazards programs include the following elements: (1) National Earthquake Hazards Reduction; (2) Hurricane Preparedness; (3) Dam Safety; (4) Radiological Emergency Preparedness; (5) Hazardous Materials; and (5) Chemical Demilitarization.

The purpose of the *National Earthquake Hazards Reduction Program* is to reduce the risk to lives and property. This is accomplished through a comprehensive, multi-agency program of scientific research, mitigation, preparedness and response planning and public education. FEMA has the statutory responsibility to plan, coordinate and recommend goals, priorities and budgets for earthquake activities among the principal agencies authorized under the Earthquake Hazards Reduction Act of 1977, as amended. The agencies include the United States Geological Service, the National Science Foundation and the National Institute for Standards and Testing.

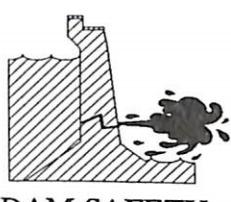
The primary activities of the program are to provide:

- for the development of improved seismic design and construction practices for adoption by Federal agencies, State and local governments and the private sector;
- financial and technical assistance to State and local governments to implement comprehensive earthquake hazard reduction programs;
- developing public education and awareness programs; and
- planning and coordinating an adequate Federal capability to respond to a catastrophic earthquake.



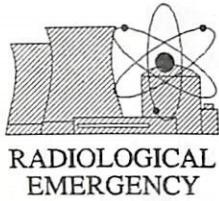
The goal of the *Hurricane Preparedness Program* is to reduce the loss of life and property damage from hurricanes in 24 high-risk populations. FEMA, as the chair of the Interagency Coordinating Committee on Hurricanes, coordinates ongoing hurricane-related planning and mitigation activities of the U.S. Army Corps of Engineers, the National Weather Service, the National Hurricane Center and the Office of Ocean & Coastal Resource Management.

The primary functions performed include: (1) conducting population preparedness projects which assist State and local governments in developing and implementing evacuation plans for coastal areas; (2) and property protection projects, which assist State and local governments in developing and implementing hazard mitigation plans for coastal areas.



The objective of the *Dam Safety Program* is to enhance the safety of the Nation's dams, thereby protecting lives and property. FEMA exercises dual responsibilities through its Dam Safety Program to (1) coordinate Federal dam safety activities and (2) coordinate and implement activities designed to encourage States to address dam safety.

FEMA chairs the Interagency Committee on Dam Safety (ICODS) and coordinates non-Federal dam safety with the Association of State Dam Safety Officials. Technical assistance is provided through the publication, revision and distribution of technical assistance materials developed by ICODS and others. In addition, FEMA activities help to bring the dam safety message to State and local officials and the private sector through the sponsoring of State public awareness workshops, informational videos, brochures and other materials.



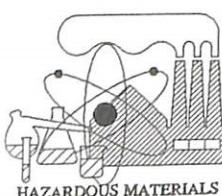
RADIOLOGICAL
EMERGENCY

As a result of a Presidential Directive in 1979, FEMA was assigned the lead Federal role for radiological emergency planning and response. Under FEMA's *Radiological Emergency Preparedness Program*, the goal is to enhance integrated emergency planning and response for all types of peacetime radiological emergencies by the State, local and Federal governments. The primary emphasis is directed to planning and preparedness for commercial nuclear power plants, nuclear fuel cycle and material license holders, Department of Defense and Department of Energy facilities and transportation accidents.

Much of the program's effort is directed towards protecting the health and safety of citizens living in the Emergency Planning Zones that are established around each commercial nuclear power plant in the United States. There are 75 commercial nuclear power plant sites nationwide involving planning and preparedness activities of 460 State, local and tribal governments. Approximately 3 million people live within the Emergency Planning Zones around these sites.

Key activities pertaining to offsite radiological emergency planning and preparedness include: evaluation of emergency response and utility plans; review of public emergency information materials; review and testing of utility alert and notification systems; periodic exercises to test emergency response plans; and periodic program activities such as drills, plan updates and public meetings.

FEMA's primary regulatory responsibilities includes the provision of FEMA findings on the adequacy of offsite planning and preparedness to the Nuclear Regulatory Commission. FEMA findings are used by the Nuclear Regulatory Commission in making licensing determinations.



HAZARDOUS MATERIALS

The mission of the *Hazardous Materials Program* is to provide technical and financial assistance to State and local governments. In addition, FEMA coordinates and cooperates with the private sector in developing, implementing and evaluating hazardous materials emergency preparedness programs for State and local governments. The mission is accomplished through five separate functional elements—planning; training; exercising; information exchange; and intergovernmental coordination/cooperation.

FEMA develops and distributes planning and preparedness guidance to State and local governments in cooperation with the 13 member agencies of the National Response Team. Hazardous materials training courses and course materials are developed and financial assistance is provided to State and local governments to support State-derived course development and delivery. FEMA supports State and local governments in the design implementation and evaluation of hazardous materials exercises used for assessing the adequacy and effectiveness of existing planning and training programs. FEMA also cooperates with the Department of Transportation in the maintenance of electronic bulletin boards to provide the latest information on hazardous materials planning, training, exercises and conferences to State and local governments and the private sector. FEMA is also working in cooperation with the Department of the Army in providing financial and technical assistance to State and local governments in the development and implementation of emergency preparedness programs at eight chemical weapons storage installations in the continental United States.

- The Disaster Relief Program** The Disaster Relief Program is designed to supplement the efforts and available resources of State and local governments and voluntary relief organizations. The President's declaration of a "major disaster" or an "emergency" authorizes Federal assistance under the Robert T. Stafford Disaster Relief and Emergency Assistance Act and triggers other Federal disaster relief programs.

As defined in "The Stafford Act":

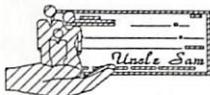
An "emergency" means any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the United States.

"Major disaster" means any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources

of State, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.

Two primary forms of Federal disaster assistance can be made available under a Presidential declaration of a major disaster: (1) assistance to individuals and (2) assistance to State and local governments.

One of the most important objectives after any disaster is to inform individuals of the assistance available and to assist them in the application and delivery process. Information outlining available aid programs is disseminated by FEMA through radio, television, newspapers, and the mass distribution of pamphlets, as well as "outreach" teams and toll-free telephone "hotlines." This "*Individual Assistance*" may include:



- temporary housing, until alternative housing is available for disaster victims whose homes are uninhabitable;
- minimum essential repairs to owner-occupied residences in lieu of other forms of temporary housing so that families can return quickly to their damaged homes;
- disaster unemployment assistance and job placement assistance for those unemployed as a result of a major disaster;
- individual and family grants of up to \$10,400 to meet disaster-related necessary expenses or serious needs when those affected are unable to meet such expenses or needs through other programs or other means;
- legal services to low-income families and individuals;
- crisis counseling and referrals to appropriate mental health agencies to relieve disaster-caused mental health problems; and
- assistance through the Cora Brown Fund to victims of natural disasters for those disaster-related needs that have not been or will not be met by government agencies or other organizations that have programs to address such needs.

Although the following forms of assistance are not FEMA programs, FEMA, as the lead agency for Federal disaster assistance, coordinates the aid provided by other Federal agencies under Presidential declarations of major disasters or emergencies:

- loans to individuals, businesses, and farmers for repair, rehabilitation, or replacement of damaged real and personal property and some production losses not fully covered by insurance;
- agricultural assistance, including technical assistance; payments covering a major portion of the cost to eligible farmers who perform emergency conservation actions on farmland damaged by a disaster; and provision of federally owned grain for livestock and herd preservation;
- veteran's assistance, such as death benefits, pensions, insurance settlements, and adjustments to home mortgages held by the Veterans Administration if a VA-insured home has been damaged;
- tax relief, including help from the Internal Revenue Service in claiming casualty losses resulting from the disaster and State tax assistance; and
- waiver of penalty for early withdrawal of funds from certain time deposits.

Assistance to State and local governments is provided as soon as practicable following the President's declaration of a major disaster. Project applications submitted by States and eligible political subdivisions of States for "*Public Assistance*" may be approved to fund a variety of projects, including:

- clearance of debris, when in the public interest or on public or private lands or waters;
- emergency protective measures for the preservation of life and property;
- repair or replacement of streets, roads and bridges;
- repair or replacement of water control facilities (dikes, levees, irrigation works, and drainage facilities);
- repair or replacement of public buildings and related equipment;
- repair or replacement of public utilities;
- repair or restoration of public facilities damaged while under construction;
- repair or replacement of recreational facilities and parks; and



- repair or replacement of eligible private nonprofit educational, utility, emergency, medical and custodial care facilities, including those for the aged or disabled, and facilities on Indian reservations.

Other forms of "*Public Assistance*" that may be made available under a Presidential declaration of a major disaster include:

- community disaster loans from FEMA to communities that may suffer a substantial loss of tax and other revenues and can demonstrate a need for financial assistance in order to perform their governmental functions;
- certain forms of hazard mitigation assistance from FEMA under its own authorities and with other Federal agencies through the interagency hazard mitigation team process;
- repairs and operating assistance to public elementary and secondary schools by the Department of Education;
- use of Federal equipment, supplies, facilities, personnel and other resources (other than the extension of credit) from various Federal agencies; and
- repairs to Federal-aid system roads when authorized by the Department of Transportation.

In many instances, disaster assistance may be obtained from the Federal government and voluntary agencies without a Presidential declaration of a major disaster or an emergency. The following are examples of the kinds of assistance from various Federal and voluntary agencies:

- *Search and Rescue Assistance* may be provided by the U.S. Coast Guard or U.S. Armed forces in search and rescue operations, to evacuate disaster victims and transport supplies and equipment.
- *Flood Protection Assistance* can be provided by the U.S. Army Corps of Engineers, which has the authority to assist in flood-fighting and rescue operations and to protect, repair and restore federally constructed flood-control works threatened, damaged or destroyed by a flood.
- *Fire Suppression Assistance* may be authorized by the President to provide aid, including grants, equipment, supplies and personnel to a State for the suppression of a forest or grassland fire on public or private lands that threatens to become a major disaster.

- *Emergency Loans for Agriculture* may be made to eligible farmers, ranchers, and aquaculturists in areas designated as eligible by the Secretary of Agriculture or the Administrator of the Farmers Home Administration.
- *Disaster Loans for Homeowners and Businesses* can be provided by the Small Business Administration (SBA) to qualified homeowners and businesses to repair or replace damaged or destroyed private property when the Administrator declares a “disaster loan area” under SBA’s statutory authorities. Economic injury loans can help small firms suffering economic losses as a result of a disaster.
- *Voluntary Agencies* provide an essential element of almost any disaster relief effort through the assistance they provide in the distribution of food, medicine and supplies, emergency shelter and the restoration of community services. The American National Red Cross provides grants and other types of assistance to individuals and families affected by disasters to meet their emergency needs. The Salvation Army, the Mennonite Disaster Service, and other charitable organizations and church groups also provide significant assistance to those in need of help.

The Federal Insurance Administration

The FEMA Federal Insurance Administration directs Federal programs dealing with flood insurance and the Unified National Program for Floodplain Management.

Congress established the National Flood Insurance Program (NFIP) with the passage of the National Flood Insurance Act of 1968. The program was broadened and modified in the Flood Disaster Protection Act of 1973.

Before the passage of the National Flood Insurance Act of 1968, national response to flood disasters consisted of constructing flood control works and providing disaster relief to flood victims. Flood losses were not reduced nor was unwise development discouraged. No insurance companies provided flood coverage for the public and building techniques to reduce flood damage were overlooked. In creating the National Flood Insurance Program, Congress provided a program for mitigating future damage from floods and an insurance mechanism for the public to obtain protection from flood losses.



The National Flood Insurance Program, which is administered by FEMA's Federal Insurance Administration, enables property owners to purchase flood insurance. It is designed to provide an insurance alternative to disaster assistance as a means of meeting escalating costs for repairing flood damage.

Local communities participate in the NFIP through an agreement with the Federal government. Under this agreement, the Federal government makes flood insurance available as a financial protection against actual flood losses if the community implements and enforces measures to reduce future flood risks to new construction in special flood hazard areas.

When a community joins the NFIP, it adopts and enforces minimum floodplain management standards. FEMA works closely with States and local communities to identify flood hazard areas and flooding risks. The floodplain requirements are designed to prevent new development from increasing the flood threat and to protect new and existing buildings from anticipated floods.

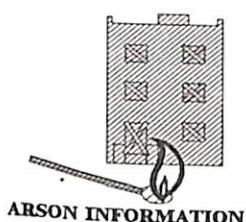
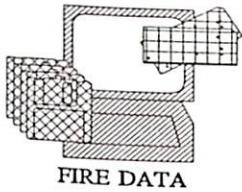
In 1981, FEMA developed the "Write Your Own" program to reinvoke the private-sector insurance companies in the NFIP. The goals of the "Write Your Own" program are:

- To increase the NFIP policy base and the geographic distribution of policies;
- To improve service to NFIP policy holders through the infusion of insurance industry knowledge; and
- To provide the insurance industry with direct operating experience with flood insurance.

**United States
Fire
Administration**

The mission of the FEMA United States Fire Administration (USFA) is (1) to enhance the Nation's fire prevention and control activities, (2) to reduce significantly the Nation's loss of life from fire and (3) to achieve a reduction in property loss and non-fatal injury due to fire. The FEMA National Fire Academy provides educational programs at the FEMA training facility located in Emmitsburg, Maryland, and through off-campus outreach courses.

The United States Fire Administration offers a wide range of programs to both fire service professionals, emergency managers and the public. These include:



The National Fire Incident Reporting System, which operates in conjunction with the National Fire Information Council. The USFA coordinates this fire data collection and analysis program on a voluntary basis with most States and a number of metropolitan areas. This system allows USFA to track fire safety trends and measures any change in the numbers of fire casualties.

The Management Application Project and the *Arson Information Management Systems Project* expands the data capabilities of the National Fire Incident Reporting System with computer software packages that manage fire data.

Community Volunteer Fire Prevention grants to 21 States and the District of Columbia fund local fire prevention and education projects.

The Firefighters Integrated Response Equipment System improves the design and performance of structural firefighters' clothing and equipment. Firefighter suits are being developed and tested to withstand hazardous chemicals and toxic gases. Field tests and studies to determine the effects of smoke and other environmental and behavioral characteristics on firefighters are being conducted.

The USFA works with the Children's Television Workshop to develop fire safety materials for use by educators, focusing on fire safety for pre-school children by using Sesame Street materials. The USFA also runs a series of educational teleconferences yearly for fire service and emergency management audiences throughout the country on subjects ranging from flammable gases and liquids to residential sprinklers, stress management, and public affairs. In addition, the USFA maintains an Arson Resource Center as an information clearinghouse on arson data for use by students of the National Fire Academy, emergency management personnel, and the public.

Summary Regardless of whether the programs listed above are provided in the form of financial assistance, technical assistance or guidance, they provide the primary system within the Federal government to assist State and local governments in developing a readiness capability against threats. They cover the full range of emergency management activities — mitigation, preparedness, response and recovery — required against the full range of natural, technological and national security emergencies, including nuclear attack.

The following is a representative list of the types of assistance that FEMA is providing under the civil defense program in 1990:

- funding of up to 50 percent of the salaries of over 6,700 full and part-time State and local emergency managers in over 2,600 jurisdictions nationwide;
- updating 892 State and local Emergency Operations Plans;
- funding tours for up to 600 military reservist Individual Mobilization Augmentees to assist State and local emergency managers in emergency planning and preparedness activities for both national security and natural and technological hazards;
- developing or updating 3,132 State and local radiological defense plans and implementing 400 State and local radiological defense exercises;
- funding 170 State and local emergency planners; and
- supporting 7,116 State and local exercises and training 459,400 participants.

These activities are in addition to the on-going support provided by civil defense-supported programs such as Emergency Operating Centers, the Emergency Broadcast System, the National Warning System, and other communications, planning, hardware, and training functions.

In addition, other agency program activities include:

- site specific final determinations and offsite emergency preparedness planning, joint exercises and remedial exercises under the Radiological Emergency Preparedness program;
- the conduct of studies and analyses, the development of policy guidance, the conduct of exercises and assessments of training courses under the hazardous materials program;

- a wide variety of earthquake preparedness activities, including FEMA's role as lead coordinating agency, seismic design, State and local hazards reduction, Federal response planning, earthquake education and information transfer, and multi-hazard planning;
- disaster preparedness, response and recovery activities under the Robert T. Stafford Disaster Relief and Emergency Assistance Act;
- the initiation of flood studies and the completion of restudies, limited flood-plain map updates, flood map revisions, erosion studies initiated, and digital maps produced under the Federal Insurance Administration; and
- a wide range of programs under the U.S. Fire Administration to enhance public awareness of the hazards of fire, fire protection and prevention measures; research codes and standards and undertake projects of anti-arson strategies, continue support for fire service leadership development through educational efforts, conferences and special publications, encourage broader involvement of the fire service in public/private partnerships in the areas of new technology and approaches to addressing fire problems, undertake research to develop superior protective clothing, tools and equipment to allow firefighters to operate more safely and effectively in emergencies and other measures to lower the rate of death, injury and illness among the nation's firefighters.

Figures 28-30 display the support provided by FEMA programs to State and local governments across the full range of threats by the financial assistance provided to the State and local governments through the FEMA Comprehensive Cooperative Agreement (CCA) process (in 1989, FEMA distributed in excess of \$95 million to State and local governments through the CCA process):

THREATS ADDRESSED BY CCA PROGRAMS

NATURAL												TECHNOLOGICAL				NATIONAL SECURITY			
Avalanche	Dam Failure	Drought	Earthquake	Flood	Hurricane / Tropical Storm	Landslide	Subsidence	Tornado	Tsunami	Volcano	Wildfire	Winter Storm (Severe)	Hazardous Material Incident	Power Failure	Radiological Incident	Transportation Accident	Structural Fire	Nuclear Attack	Civil Warfare
																			Low Intensity Conflict
CIVIL DEFENSE PROGRAMS																			
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DCW	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	EMA	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	EMT	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	FS	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	IMA	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	PPP	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	RADEF	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	SLE	
NATURAL AND TECHNOLOGICAL HAZARD PROGRAMS																			
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	CAP	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	CSD	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DPIG	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DS	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	EP	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	HAZMAT	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	HMA	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	HP	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	REP	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	EMI	

Note: No (✓) check means no funding provided directly to States.

LEGEND

DCW:	Direction, Control & Warning	CSD:	Chemical Stockpile Disposal
EMA:	Emergency Management Assistance	DPIG:	Disaster Preparedness Improvement Grants
EMT:	Emergency Management Training	DS:	Dam Safety
FS:	Facility Survey	EP:	Earthquake Preparedness
IMA:	Individual Mobilization Augmentee	HAZMAT:	Hazardous Materials
PPP:	Population Protection Planning	HMA:	Hazard Mitigation Assistance
RADEF:	Radiological Defense	HP:	Hurricane Preparedness
SLE:	State and Local Exercises	REP:	Radiological Emergency Preparedness
CAP:	Community Assistance Program	EMI:	Emergency Management Institute

Figure 28

FY 89 FUNDING TO STATES

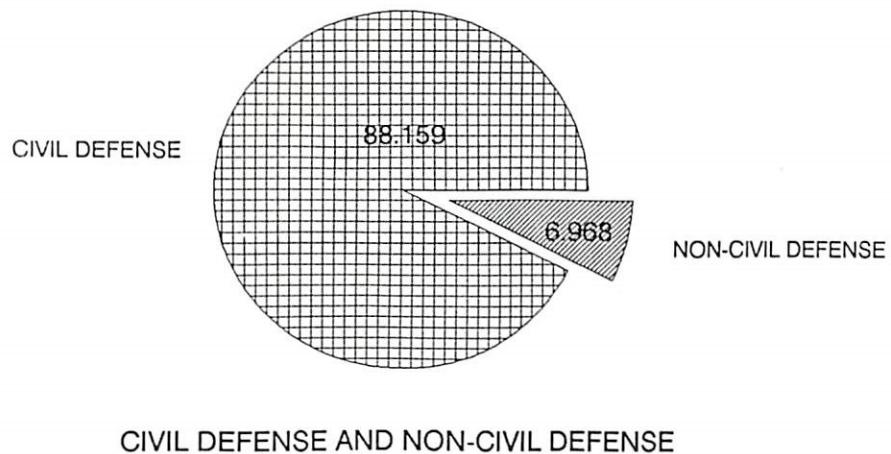


Figure 29

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APPENDIX – STATE HAZARD MAPS

DATE DUE

54826

15800 1990
Principal threats facing
communities and local
emergency management
coordinators

DATE LOANED	BORROWER'S NAME	DATE RETURNED

National Emergency Training Center

Learning Resource Center
16825 South Seton Avenue
Emmitsburg, MD 21727

NETC LRC



058121



54826

DEHCO

54826

15800 1990
Principal threats facing
communities and local
emergency management
coordinators