



# CERT Hazard Annexes

Participant Manual



FEMA



[This page intentionally left blank]



# CERT Hazard Annex: Avalanche

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

An avalanche is a large mass of snow rapidly moving down a mountainside that can travel as fast as 80 miles per hour (mph). When it stops, the snow debris left behind can become as solid as concrete. While primarily a phenomenon in the western United States, avalanches can also occur in mountainous regions of the Northeast.

### Avalanche Impacts

There are many impacts on people, property, and infrastructure associated with avalanches.

- Typically, a combination of asphyxia, trauma, and hypothermia cause avalanche fatalities. In an average winter, 28 people die from avalanches in the United States.
- Avalanches disrupt transportation, power and other services, and cause economic losses from damages to structures and roadways.

### Avalanche Facts

Avalanches can occur in dry or wet snow as either slab or sluff avalanches. A dry snow avalanche occurs in dry snow at below freezing temperatures. A wet snow avalanche usually occurs when warm air temperatures, sun, and/or rain cause water to percolate through the snowpack and decrease the strength of the snow. In some cases, this changes the mechanical properties of the snow. Dry avalanches often fail because of an increase in load compared to wet slabs that fail because of a decrease in layer strength.

- **Slab avalanches:** A “slab” is a cohesive plate of snow that slides as a unit on the snow underneath.
  - Dry slab avalanches are the deadliest and account for nearly all the avalanche deaths in North America. The bonds holding a slab in place typically fracture at 220 mph and it appears to shatter like a pane of glass. Dry slab avalanches can lie patiently, teetering on the verge of catastrophe, sometimes for days to even months.
  - Wet slab avalanches often occur during prolonged warming events and/or rain-on-snow events. Wet slab avalanches can be very destructive, and they often occur first at lower elevations and areas with a shallower snowpack.
- **Sluff avalanches:** Also known as loose snow or point release avalanches, sluffs usually start from a point and fan outward as they descend. Sluffs kill very few people because they tend to be small and tend to fracture beneath you as you cross a slope instead of above you as slab avalanches often do.

Once initiated, wet snow avalanches tend to travel much more slowly than dry snow avalanches. Wet snow avalanches are harder for a person to trigger than a dry slide. Therefore, wet avalanches do not account for nearly as many avalanche fatalities as dry

snow avalanches. However, they still account for a sizeable percentage of avalanche fatalities—especially to climbers—in maritime climates.

A typical wet avalanche travels between 10 and 20 mph while a typical dry snow avalanche travels at speeds of between 60 and 80 mph. About 90 percent of all avalanches start on slopes of 30 – 45 degrees. Avalanche fatalities in the United States tend to occur in locations with mountains and significant snow. This includes the western states and Alaska, but they also occur in northeastern states.

## Avalanche Preparedness

- Training in how to recognize and avoid avalanches is critical for anyone who goes where avalanches are possible. The U.S. Forest Service (USFS) National Avalanche Center states, “The best way to stay safe is to know the conditions, get the training, carry rescue gear, and stay out of harm’s way.” Contact your local or regional avalanche center for a list of avalanche classes.
- Obtain proper equipment and training to support rescue, mitigate head injuries, and create air pockets. Everyone should travel in pairs, obtain avalanche survival training, carry a working multi-function (i.e., transmit and receive) avalanche beacon on their body, a small portable shovel and an avalanche probe in a backpack. Also, consider wearing a helmet and carrying an avalanche airbag.
- Consider the following precautions when in avalanche-prone areas:
  - Avoid slopes steeper than 30 degrees.
  - Avoid runout zones under slopes steeper than 30 degrees.
  - Pay attention to immediate warning signs, which include recent avalanches, shooting cracks, and “whumpfung” sounds.
  - Avoid particularly dangerous areas, slopes, and terrain even if the regional advisory is low.
  - Note that avalanche prone areas near highways are usually marked with signs.
    - Do not stop your car in these areas.
    - Keep moving until out of the avalanche prone area, as steep embankments along roadsides are particularly susceptible to avalanches.
- Sign up for local alerts and warnings. Local areas with avalanche terrain may have warning systems and evacuation plans for serious avalanche conditions.
- Monitor local news and weather reports.
- The USFS and its 14 regional avalanche centers issue Advisories and Warnings in dangerous conditions using the five category Danger Scale to communicate travel advice, the likelihood of avalanches, and the size and distribution of avalanches. **Table 1** below displays the meaning of the North American Public Avalanche Danger Scale levels.

**Table 1: North American Public Avalanche Danger Scale**

Danger Level	Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
<b>Extreme</b>	Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
<b>High</b>	Very dangerous avalanche conditions. Travel in <b>avalanche</b> terrain is not recommended.	Natural avalanches likely; human-triggered avalanches very likely.	Large avalanches in many areas; or very large avalanches in specific areas.
<b>Considerable</b>	Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding, and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
<b>Moderate</b>	Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
<b>Low</b>	Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.

- If you live in an area with a risk of an avalanche, consider consulting a professional about placement and mitigation structures such as retention structures, redistribution structures, and retarding or catchment structures.

### During an Avalanche

The suddenness of an avalanche requires that people be prepared to act quickly. In the event you experience an avalanche, you must put implement your training and operate your equipment effectively and efficiently.

- If buried in an avalanche, before the snow stops moving, cup your hand in front of your face to clear airspace and expand your chest if possible. Helmets can provide the necessary airspace if still in place. Also, relax to conserve oxygen.

DO NOT YELL. Rescuers will not be able to hear you even though you will be able to hear them.

### **After an Avalanche**

- If an avalanche buries your partner, make a brief call to 9-1-1 before you initiate an immediate search. Rescued victims will likely require immediate medical attention. Treatment for suffocation, hypothermia, traumatic injuries, and/or shock is commonly required for avalanche victims.
- Stay away from avalanche areas. There may be danger of additional slides.
- If a building has been hit by an avalanche, check for signs of structural damage. Consider having it assessed by a professional.

[This page intentionally left blank]

[This page intentionally left blank]



# CERT Hazard Annex: Earthquake

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

An earthquake is the sudden, rapid shaking of the earth, caused by the breaking and shifting of subterranean rock as it releases strain that has accumulated over a long time. Earthquake hypocenters are usually less than 50 miles below the Earth's surface and are accompanied and followed by a series of vibrations. The epicenter—the point where an earthquake originates—is directly above the hypocenter on the surface. Earthquakes occur without any obvious warning.

There is no seasonal or yearly cycle of earthquake occurrence; earthquakes can happen at any time.

An earthquake may last for seconds or minutes, while aftershocks may occur hours, days, or months after the main earthquake.

### Earthquake Impacts

Earthquakes threaten lives, property, and the environment. Shaking ground from an earthquake can:

- Cause buildings to move off their foundations or collapse;
- Send household items flying, making them dangerous projectiles;
- Damage utilities and roads;
- Cause fires and explosions; and
- Cause structural instability, such as dam failures that can trigger flash floods.

### Earthquake Facts

Earthquakes can trigger other hazards such as avalanches, fires, floods, landslides, and tsunamis. It is very important to listen for emergency instructions after the shaking stops.

Many parts of the United States carry significant risk of experiencing an earthquake. Some notable areas include:

- The western United States, particularly along the San Andreas Fault in California, the Cascadia Subduction Zone in western Oregon and Washington, and the Aleutian-Alaska Subduction Zone along the Alaskan coast.
  - California faces the highest risk of earthquakes, followed by Washington State.
- The New Madrid Fault Zone, spanning southeastern Missouri, northeastern Arkansas, western Tennessee, and western Kentucky.
  - According to a 2015 study, more than eight million people are within the destructive reaches of the New Madrid Fault.
- Areas on the east coast, including the Mid-Atlantic, coastal South Carolina and New England.

Although hundreds of tremors are felt each year, particularly in California, major earthquakes are rare. Five major earthquakes have occurred in the last century in the United States:

- San Francisco Bay Area, California 1906 (700 - 800 lives lost)
- Prince William Sound Area, Alaska, 1964 (129 lives lost)
- Sylmar-San Fernando Area, California, 1971 (65 lives lost)
- San Francisco Bay Area, California, 1989 (63 lives lost)
- Los Angeles Area, California, 1994 (57 lives lost)

Intensity and magnitude are the two measures used to characterize an earthquake. The effect of an earthquake on the Earth’s surface is called the intensity. The Modified Mercalli Intensity (MMI) Scale measures intensity based on observed effects. The magnitude is a number that characterizes the relative size of an earthquake. The Richter Scale measures magnitude based on measurement of the maximum motion recorded by a seismograph. The MMI Scale is now more widely used than the Richter scale for classifying earthquakes.

**Table 2** below displays intensity levels that are typically observed at locations near the epicenter of earthquakes, while **Table 3** provides an abbreviated, modified Mercalli Intensity Scale.

**Table 2: Earthquake Measures**

Magnitude	Typical Maximum Modified Mercalli Intensity
<b>1.0 – 3.0</b>	I
<b>3.0 – 3.9</b>	II – III
<b>4.0 – 4.9</b>	IV – V
<b>5.0 – 5.9</b>	VI – VII
<b>6.0 – 6.9</b>	VII – IX
<b>7.0 and higher</b>	VIII or higher

**Table 3: Abbreviated Modified Mercalli Intensity Scale**

Scale	Description
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

## Earthquake Preparedness

- Know what to do during an earthquake.
- Practice how to Drop, Cover, and Hold On. Dropping to your hands and knees on the floor minimizes risk of falling. Covering your head and neck or crawling to additional cover under a study desk or table if safe to do so protects against falling objects. Stay away from anything that could fall and hold on until the shaking stops.
- Conduct earthquake drills with your family or coworkers. Locate safe spots (e.g., under a sturdy table), and identify danger zones (e.g., near windows).
- Develop a family communication plan. This includes identifying an out of state contact, informing that person of the duties and expectations that duty entails. Develop a plan for reuniting all family members after an earthquake occurs.
- Keep supplies on hand, including food and water for at least three days, a flashlight with extra batteries, a portable radio, a fire extinguisher, and tools (see *Disaster Supply Kit* in CERT Basic Training Unit 1).
- Keep shoes and a flashlight under the bed. Keeping shoes under the bed ensures quick access to prevent cutting feet on glass and reduces the risk that glass could fall into them.
- Secure bookshelves, water heaters, and tall furniture to wall studs. Install latches on all cabinets, and anchor overhead lighting fixtures. Secure items that might fall (e.g., televisions).
- Store heavy and breakable objects on low shelves.
- Move beds away from windows. Move or secure hanging objects over beds, couches, and other places where people sit or lie.
- Have a licensed professional install flexible pipe to avoid gas or water leaks. It is a good idea to consult a structural engineer to evaluate your home.
- Ask questions about home repair and strengthening for exterior features, such as porches, decks, sliding doors, canopies, carports, and garage doors.

## During an Earthquake

During earthquakes in the United States, most injuries result from people falling and/or being hit by household and nonstructural debris, rather than being hurt in collapsing buildings. Many injuries can be avoided if people take appropriate steps to prepare.

Follow these measures to stay safe during an earthquake:

- Drop, cover, and hold on. Drop to your hands and knees. Cover your head and neck with your arms. Hold on to any sturdy shelter until the shaking stops. Move only as far as necessary to reach cover from debris and potential structural damage. The objective is to avoid debris, so it may be safer to stay where you are to avoid going through areas with dangerous debris such as windows or unsecured heavy items. Do NOT get in a doorway as this does not provide

protection from falling or flying objects and you will likely not be able to remain standing.

- Do NOT run outside. If indoors, it is safer to stay indoors until the shaking stops and it is safe to exit. When going outdoors, move quickly away from the building to prevent injury from falling debris.
- If outdoors and possible, find a spot away from buildings, trees, streetlights, overpasses and power lines. **Drop, cover and hold on.** Stay there until the shaking stops. Injuries can occur from falling trees, street lights, and power lines, or building debris. In a city, you may need to duck inside a building to avoid falling debris.
- If in a vehicle, pull over at a clear location free of hazards and stop as quickly and safely as possible. Stay in the vehicle with your seatbelt fastened until the shaking stops. Avoid stopping near or under buildings, trees, overpasses, and utility wires. Turn on the radio to get information regarding the quake and any damage to roadways that may have occurred. Proceed cautiously once the earthquake has stopped. Avoid roads, bridges, or ramps that the earthquake may have damaged.
- If in bed, stay there and cover your head and neck with a pillow. At night, hazards and debris are difficult to see and avoid. Attempts to move in the dark result in more injuries than remaining in bed.

Tips based on the area in which you live:

- If in a high-rise building, expect the fire alarms and sprinklers to go off during an earthquake. Check for and extinguish small fires. Do not use the elevators.
- Earthquakes can generate tsunamis. If you are near the coast, learn the tsunami risk for your area. If you are in an area that may experience tsunamis, when the shaking stops, walk inland or to higher ground immediately. Monitor official reports for more information on the area's tsunami evacuation plans.
- If in a mountainous area or near unstable slopes or cliffs, be alert for falling rocks and other debris that could be loosened by the earthquake. Also, watch for avalanches or landslides that could be triggered by the earthquake.

## After an Earthquake

Immediately following an earthquake, take the following steps:

- If you are trapped, do not move around or kick up dust. Cover your mouth with a handkerchief or clothing. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust. Use your cell phone to call or text for help. Tap on a pipe or wall or use a whistle, if available, so rescuers can locate you.
- If you are in a damaged building and there is a safe way out through the debris, leave and go to an open space outside. If you can do so safely, take a moment to take what you might need immediately and can carry easily (e.g., a purse, go bag, etc.). Once outside, do not re-enter until the building is certified to be safe.

- Check yourself for injuries. Often, people tend to check on others without checking themselves. You will be better able to help others if you are not injured or if you have received first aid for your injuries.
- Protect yourself from further danger by putting on long pants, a long-sleeved shirt, sturdy shoes or work boots, and work gloves.

After you have taken care of yourself, you should:

- Check others for injuries and offer aid if you have training. Assist with rescues if you can do this safely.
- Look for and extinguish small fires.
  - Fire is the most common hazard following earthquakes. Extinguishing small fires and eliminating fire hazards will minimize the risk of a fire getting out of control.
  - Never use a lighter or matches near damaged areas.
- Clean up spills.
  - By cleaning up medicines, bleaches, flammables, and other spills, it is possible to prevent many small but potentially dangerous hazardous materials emergencies.
- Inspect the home for damage.
  - Aftershocks can cause additional damage to unstable buildings. If there are major cracks in the chimney or foundation, or if the home and its utilities have been moved by the earthquake, get everyone out of the home. If safe, take photographs of the home and its contents to document insurance claims.
- Tune to the Emergency Alert System (EAS).
  - The EAS will broadcast information and instructions. Monitor local news reports (e.g., battery-operated radio, TV, and cell phone text alerts) for emergency information and instructions.
- Expect aftershocks.
  - Aftershocks often occur minutes, days, or weeks following an earthquake. When aftershocks occur, **drop, cover, and hold on**.
- Help neighbors who may require assistance.

**Table 4** below reviews some common myths about earthquakes and explains why each is not true.

**Table 4: Earthquake Myths and Facts**

Myth	Fact
<p><b>“Mega-Quakes” can happen.</b></p>	<p>Strictly speaking, mega-quakes of magnitude 10 or more are possible; however, scientists agree that they are implausible. The magnitude of an earthquake is related to the length of the fault on which it occurs—the longer the fault, the larger the earthquake. The San Andreas Fault is only 800 miles long. To generate an earthquake of 10.5 magnitude would require the rupture of a fault that is many times the length of the San Andreas Fault. No fault long enough to generate a magnitude 10.5 earthquake is known to exist. The largest earthquake ever recorded was a magnitude 9.5 on May 22, 1960 in Chile on a fault that is almost 1,000 miles long.</p>
<p><b>Earthquakes only occur on the West Coast of the United States.</b></p>	<p>Earthquakes can strike any location at any time, but history shows they occur in the same general patterns over time. Principally, earthquakes strike in three large zones of the earth. The world’s greatest earthquake zone, the circum-Pacific seismic belt, is found along the rim of the Pacific Ocean, where about 81 percent of the world’s largest earthquakes occur. That belt extends from Chile, northward along the South American coast through Central America, Mexico, the West Coast of the United States, the southern part of Alaska, through the Aleutian Islands to Japan, the Philippine Islands, New Guinea, the island groups of the Southwest Pacific, and to New Zealand.</p> <p>The second important belt, the Alpide, extends from Java to Sumatra through the Himalayas, the Mediterranean, and out into the Atlantic and accounts for about 17 percent of the world’s largest earthquakes, including some of the most destructive. The third prominent belt follows the submerged Mid-Atlantic ridge.</p> <p>Earthquakes in these prominent seismic zones are taken for granted, but damaging shocks occur occasionally outside these areas. These shocks are scattered in various areas of the world including New Madrid in the United States, which stretches through Missouri, Arkansas, and Tennessee. Many decades to centuries, however, usually elapse between such destructive shocks.</p>
<p><b>The 1906 San Francisco earthquake was the deadliest ever.</b></p>	<p>The well-known magnitude 7.8 San Francisco earthquake and ensuing fire killed 700 – 800 and razed large sections of the city. It was the deadliest in U.S. history, but that doesn’t make it the worst the world has seen, by far.</p> <p>The deadliest earthquake in recorded history struck Shensi province in China in 1556, killing about 830,000 people. The 1976 magnitude 7.8 earthquake which struck Tangshan, China killed somewhere between 250,000 and 800,000 people. In 2003, the magnitude 6.5 earthquake in Bam, Iran killed more than 40,000 people.</p> <p>The earthquake in Chile on May 22, 1960, is the strongest to be recorded in the world with magnitude 9.5 and killed more than 4,000. For the record, the largest U.S. earthquake occurred on March 28, 1964, in Alaska. It was a magnitude 9.2 quake and took 131 lives.</p>
<p><b>California has the most earthquakes in the United States.</b></p>	<p>Alaska registers the most earthquakes in a given year, with California placing second. California, however, has the highest risk and most damaging earthquakes because of its greater population and extensive infrastructure. Florida and North Dakota have the fewest earthquakes each year.</p>

Myth	Fact
<p><b>People can stop earthquakes.</b></p>	<p>We cannot prevent earthquakes from happening (or stop them once they've started). However, we can significantly mitigate their effects by characterizing the hazard (e.g., identifying earthquake faults, unconsolidated sediment likely to amplify earthquake waves, and unstable land prone to sliding or liquefying during strong shaking), building safer structures, and preparing in advance by taking preventative measures and knowing how to respond.</p>
<p><b>Lots of small earthquakes can prevent large earthquakes.</b></p>	<p>Seismologists have observed that for every magnitude 6 earthquake there are about 10 of magnitude 5, 100 of magnitude 4, 1,000 of magnitude 3, and so forth as the events get smaller and smaller.</p> <p>This sounds like a lot of small earthquakes, but there are never enough small ones to eliminate the occasional large event. It would take 32 magnitude 5 earthquakes, 1,000 magnitude 4 earthquakes, and 32,000 magnitude 3 earthquakes to equal the energy of one magnitude 6 event. So, even though we always record many more small events than large ones, there are far too few to eliminate the need for the occasional large earthquake.</p>
<p><b>We can predict earthquakes.</b></p>	<p>There currently is no accepted method to accomplish the goal of predicting the time, place, and magnitude of an impending quake. Research into earthquake prediction continues. However, the USGS approach has been to focus on providing long-range forecasts of the most probable locations and impacts of damaging earthquakes.</p> <p>For example, scientists estimate that over the next 30 years the probability of a major earthquake occurring in the San Francisco Bay area is 62 percent and 60 percent in Southern California. Scientists are also able to predict the type of ground motion to expect based on the geology and the history of earthquake activity of the region. Engineers and building code developers use these models of site response to improve the safety of structures, thereby reducing the ultimate earthquake risk.</p>
<p><b>Good building codes mean safe buildings.</b></p>	<p>Architects and engineers are using knowledge learned from past earthquakes to make roads, bridges, and buildings safer in the event of major earthquakes. Local officials are also enacting new building codes to ensure new buildings are built with earthquake safety in mind. This includes both improving the design of new buildings and bridges. It also includes strengthening older units to incorporate the latest advances in seismic and structural engineering. But the best building codes in the world do nothing for buildings built before that code was enacted. While the codes have been updated, the older buildings are still in place. Fixing problems in older buildings—also known as retrofitting—is the responsibility of the building's owner.</p>

Myth	Fact
<p><b>Earthquakes kill people.</b></p>	<p>In an earthquake, the severity of the shaking can cause manmade and natural structures and the contents within these to fail or fall and injure or kill people. There have been large earthquakes with very little damage because they caused little shaking and/or buildings were built to withstand that shaking. In other cases, smaller earthquakes have caused great shaking and/or buildings collapsed that were never designed or built to survive shaking.</p> <p>Much depends on two variables: geology and engineering. From place to place, there are great differences in the geology at and below the ground surface. Different kinds of geology will do different things in earthquakes. For example, shaking at a site with soft sediments can last three times as long as shaking at a stable bedrock site such as one composed of granite. Local soil conditions also play a role, as certain soils greatly amplify the shaking in an earthquake. A soft, loose soil will shake more intensely than hard rock at the same distance from the same earthquake. Fires are another major engineering risk during earthquakes as gas lines may be damaged and particularly hazardous.</p>
<p><b>During an earthquake, you should head for the doorway.</b></p>	<p>During previous earthquakes in unreinforced masonry structures and adobe homes, the door frame may have been the only thing left standing in the aftermath of an earthquake. However, in modern homes doorways are no stronger than any other parts of the house and usually have doors that can swing and injure you. You are safer practicing the “Drop, Cover, and Hold On” maneuver under a sturdy piece of furniture like a strong desk or table.</p>
<p><b>Everyone will panic during the Big One.</b></p>	<p>A common belief is that people always panic and run around madly during and after earthquakes, creating more danger for themselves and others. Research shows that people usually take protective actions and help others both during and after the shaking. Most people don't get too shaken up about being shaken up!</p>

[This page intentionally left blank]



# CERT Hazard Annex: Extreme Heat

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

Conditions of extreme heat are defined as higher than average temperatures in a region for that time of year. These higher than average temperatures are often combined with high humidity. The “Heat Index” is a measure of how hot it really feels when meteorologists factor in relative humidity with the actual air temperature. Extreme heat criteria shift by location and time of year.

Extreme heat kills more than 600 people in the United States every year. Most heat-related deaths and illnesses are preventable, but heat stroke can be life threatening. The elderly and the very young are at increased risk from extreme heat. Individuals with medical issues such as heart problems or high blood pressure are more easily impacted. Being confined to bed and living on higher floors of multistory buildings are also associated with an increased risk of heat-related death.

### Extreme Heat Impacts

Under normal conditions, the body’s internal thermostat produces perspiration that evaporates and cools the body. However, during periods of extreme heat and high humidity, evaporation slows, and the body works extra hard to maintain its normal temperature. Studies indicate extreme heat that continues for periods longer than two days—often denoted as a heat wave—causes a significant rise in heat-related illnesses. Spending several hours each day in air conditioning can reduce the risk of heat-related illness.

People living in urban environments may be at particularly increased risk of death from ambient heat exposure. Urban areas typically have higher heat indexes (combinations of temperature and humidity) than surrounding suburban or rural areas. Urban asphalt and concrete store heat longer and gradually release the heat at night. This can produce higher nighttime temperatures, a phenomenon known as the “urban heat island effect.”

The impacts associated with a heat wave can include three main related illnesses: heat cramps, heat exhaustion, and heat stroke. You should know the symptoms, be ready to provide aid, and know when to seek medical attention (See the CDC guide available at <https://www.cdc.gov/disasters/extremeheat/index.html>).

### Extreme Heat Preparedness

To protect against extreme heat in the home:

- Install additional insulation. Insulation helps to keep heat out in the summer as well as to keep heat in during the winter months.
- Protect windows and glass doors. Consider keeping storm windows installed throughout the year.
- Use attic fans. Because heat rises, attic fans can help clear the hottest air from the home.
- Install window air conditioners snugly and insulate if necessary.

- Inspect air conditioning ducts for proper insulation.
- Install temporary window reflectors (for use between windows and drapes), such as aluminum foil-covered cardboard, to reflect heat back outside.
- Weather-strip doors and windowsills to keep in the cool air.
- Cover windows that receive morning or afternoon sun with drapes, shades, awnings, or louvers.

It is highly important to watch and listen to weather reports for the three heat-related products from the National Weather Service (NWS) Forecast Office, based on the Heat Index. The NWS issues the following products when an excessive heat event is likely:

1. **Excessive Heat Outlooks:** The potential exists in the next 3 to 7 days.
2. **Excessive Heat Watches:** Conditions are favorable in the next 24 to 72 hours.
3. **Excessive Heat Warnings:** An event is expected in the next 36 hours.

## During Extreme Heat

During a heat wave you should:

- Seek air conditioning. If your home does not have air conditioning, seek areas that do. Schools, libraries, shopping malls, community centers, and many other public places offer good refuges during extreme heat.
- While electric fans may provide comfort, they do not prevent heat-related illness when the temperature reaches into the high 90s. Because of the limits of conduction and convection, using a portable electric fan alone when heat index temperatures exceed 99 degrees Fahrenheit actually increases the heat stress the body must respond to. This is due to the blowing air that is warmer than the ideal body temperature over the skin surface.
- Avoid overexertion and strenuous activities, especially during the hottest period of the day. Heat-related illnesses can strike quickly, especially for those who perform strenuous work during the day.
- Wear loose-fitting, lightweight, light-colored clothing. Avoid layers and heavier fabrics such as wool. Choose polyester or cotton whenever possible as they “breathe” better. Polyester is not as absorbent as cotton; and therefore, polyester allows sweat to evaporate more efficiently than cotton. Light colors reflect the sun’s rays better than dark colors, which absorb the heat. Protect the face and head by wearing a wide-brimmed hat.
- Check on family members and neighbors who do not have air conditioning and those with medical problems. This makes them particularly susceptible to heat-related illnesses.
- Drink plenty of fluids. Dehydration can occur quickly, go unnoticed, or be mistaken for other illnesses. Increasing fluid intake, even if not thirsty, can reduce

the risk of dehydration. However, people on fluid-restrictive diets (e.g., those with kidney disease) should consult their doctors before increasing fluid intake.

- Take frequent breaks. Taking frequent breaks and seeking shade allows the body to cool down.
- **Heat cramps:** Heat cramps are often the first signal that the body is suffering extreme heat.
  - **Symptoms:** Muscular pains or spasms, usually in the abdomen, arms, or legs, which may occur with strenuous activity.
  - **Actions:** Get the person to a cooler location and remove excess clothing. Give cool sports drinks containing salt and sugar or water if sports drinks aren't available. Do not give liquids with caffeine or alcohol. Discontinue liquids if the victim is nauseated. Seek medical attention if the cramps do not subside in one hour; the victim has heart problems; or the victim is on a low-sodium diet.
- **Heat exhaustion:** More severe than heat cramps, heat exhaustion results from a loss of water and salt in the body. It may develop quickly after extended exertion, or slowly after days of conditions of extreme heat and excessive sweating without adequate fluid and salt replacement.
  - **Symptoms:** Heavy sweating, paleness, muscle cramps, tiredness, weakness, dizziness, headache, nausea or vomiting, and/or fainting.
  - **Actions:** Move the victim to an air-conditioned place and lie him or her down. Loosen or remove excess clothing. Lower the victim's body temperature by placing them in a cool shower or bath, or by applying cool, wet cloths. Give sips of water or cool sports drinks containing salt and sugar. Do not give liquids with caffeine or alcohol. Discontinue liquids if victim is nauseated. Seek immediate medical attention if the victim does not improve, is unable to take fluids, begins vomiting, or exhibits any severe symptoms. In addition, seek medical attention if the victim has heart problems or high blood pressure or if the symptoms worsen or last for longer than an hour.
- **Heat stroke:** Heat stroke is the most serious heat-related illness as it can cause permanent injury or even death. It requires immediate medical attention. It occurs when the body is no longer able to regulate temperature and is unable to cool down. The body's temperature rises rapidly, the sweating mechanism fails, and the body is unable to cool down. Body temperature may rise to 106 degrees Fahrenheit or higher within 10 to 15 minutes.
  - **Symptoms:** An extremely high body temperature (i.e., above 103 degrees Fahrenheit) taken orally; red, hot, and dry skin with no sweat; rapid, strong pulse; throbbing headache; dizziness; nausea; confusion; and/or unconsciousness.
  - **Actions:** Call 9-1-1 for emergency medical services or get the victim to a hospital immediately. Delay can be fatal. Until the emergency medical

personnel arrive on scene or during transport to the hospital, take the following measures:

- Move the victim to a cooler environment and remove the victim's excess clothing; cool the victim using whatever methods are available.
- Try a cool bath, sponging, ice packs, or wrap the victim's body in a cold, wet sheet to reduce core body temperature;
- Monitor body temperature and continue cooling efforts until the body temperature reaches 101 – 102 degrees Fahrenheit;
- Do not give the victim fluids to drink;
- Watch for breathing problems; and
- Call the hospital emergency room for more instructions if there is a delay in the medical response.

Sometimes a victim's muscles will begin to twitch uncontrollably because of heat stroke. If this happens, keep the victim from injury but do not place any object in the mouth and do not give fluids. Turn the victim on his or her side to make sure the airway remains open in case the victim begins vomiting.

**Table 5** below reviews some common myths about extreme heat and explains why each is not true.

**Table 5: Extreme Heat Myths and Facts**

<b>Myth</b>	<b>Fact</b>
<b>Stay in the home during a heat wave.</b>	Air conditioning in homes and other buildings markedly reduces danger from the heat. If you must stay in a home where air conditioning is not available, stay on the lowest floor, out of the sunshine. If possible, choose other places with air conditioning (e.g., shopping mall, movie theater, public library) to seek relief from the heat during the hottest part of the day.
<b>Beer and alcoholic beverages are best to satisfy thirst in extreme heat.</b>	Although beer and alcohol appear to satisfy thirst, they actually cause additional dehydration. Unless you are on a fluid-restricted diet, drink water during a heat wave, even if you do not feel thirsty.
<b>During extreme heat, the best time to exercise is during the late morning and early afternoon.</b>	Many heat emergencies occur in those who exercise or work during the hottest part of the day. Reduce, eliminate, or reschedule strenuous activities. If you must do strenuous activity, do it during the coolest part of the day, which is usually in the morning between 4 a.m. and 7 a.m.
<b>Heat stroke is not a life-threatening condition.</b>	A heat stroke (sometimes referred to as “sun stroke”) is life threatening. The victim’s temperature control system, which produces sweating to cool the body, stops working. The body temperature can rise so high that brain damage and death may result if the body is not cooled quickly.
<b>You can only get a sunburn on hot days</b>	Ultraviolet (UV) exposure is a year-round issue, so sunburn can occur 365 days per year, and clouds may only provide partial protection. The sun emits three wavelengths of UV light: UVA, UVB, and UVC. However, UVC light does not reach the Earth’s surface. Sunburn is the direct result of over-exposure to UVA and UVB radiation. You cannot see or feel UV rays, but they can be quite damaging. Researchers have linked UV exposure to skin cancer and other skin disorders, cataracts and other eye damage, and immune system suppression.

[This page intentionally left blank]



# CERT Hazard Annex: Fire

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

The Fire Hazard Annex to the CERT Basic Training course provides a high-level overview of hazard-specific information for communities to use to better prepare their residents for indoor and outdoor fires.

Roughly 85 percent of all fire deaths occur where people sleep, such as in homes, dormitories, barracks, or hotels. Most fatal fires occur when people are less likely to be alert, such as during nighttime sleeping hours.

Nearly all home and other building fires are preventable, even arson fires. Juveniles, for example, cause the majority of arson fires. However, juveniles often respond positively to counseling. No home fire is inevitable.

Wildfires are unwanted and unplanned fires that occur outside of the home in natural spaces. Improper design, combustible materials and landscaping, and lack of attention to weed abatement in woodland residential areas contribute to the hazard.

Individuals are responsible for starting as many as 90 percent of wildfires, intentionally and accidentally, in the United States annually. The leading causes of accidental wildfires include debris burning, equipment use, and campfires.

## Fire Impacts

In 2015, there were a reported 1,345,500 home fires and wildfires in the United States, which resulted in 3,280 deaths and 15,700 injuries. \$14.3 billion in property damage was reported.

Children and the elderly represent a disproportionate percentage of fire victims. Children playing with fire account for 25 percent of the fires that kill young children in the United States every year.

## Fire Facts

Fires pose numerous dangers, including:

- **Asphyxiation:** Asphyxiation, not burns, is the leading cause of death in a fire, by a three-to-one margin.
- **Heat:** A fully developed room fire has temperatures that can exceed 1,100 degrees Fahrenheit.
- **Smoke:** Fire generates black, impenetrable smoke that blocks the vision, stings the eyes, and clogs the lungs.

Wildfires can be particularly dangerous because they often begin unnoticed and many can spread quickly, igniting brush, trees, and homes.

General patterns of wildfire spread are:

- **Ground fires:** Burn through organic matter in the soil beneath surface litter and are sustained by glowing combustion.
- **Surface fires:** Spread with a flaming front and burn leaf litter, fallen branches, and other fuels located at ground level.

- **Crown fires:** Burn through the canopy, or top layer of foliage of a tree. Crown fires are the most intense type of fire and often the most difficult to contain. They need strong winds, steep slopes, and a heavy fuel load to continue burning, which makes them difficult to fight.

Wildfires can occur anywhere in the country. They can start in remote wilderness areas, in national parks, or even in your own backyard. As building development expands into wilderness areas, homes and businesses may be increasingly at risk. This zone of transition between unoccupied land and human development is known as the wildland urban interface.

## Home Fires

### *Home Fire Preparedness*

The key to fire preparedness is a family fire plan. Every family fire plan should include:

- Smoke alarms on every level of the home and near all sleeping areas.
- Two escape routes from every room in the home. Escape ladders should be a consideration for sleeping areas on upper floors. These ladders should be stored near windows.
- Practice the escape plan at least twice each year. Practice getting out during the day and night. Practice escapes should include low-crawl escapes, ensuring that all family members' heads are one to two feet above the floor. As part of your fire escape plan, select a safe area outside the home for the family to gather after escaping the fire. Ensure that each family member knows to meet at that place so, when firefighters arrive, they can be notified quickly of family status.
- Practice alerting family members by yelling "Fire!" several times. In a real fire, this alert may help family members escape.
- Learn the fire department's emergency number, especially if the community does not have 9-1-1 service. Make sure all family members know to escape the fire first, and then call the fire department from a neighbor's home or from your own cell phone once safely removed from the fire.

It is very important to discuss with the entire family what to do in a fire. Every family member needs to know what to do in case the entire family is not together when a fire occurs. Awareness helps to reduce fear and ensures that all family members know what to do.

To help prevent fires in your home:

- Conduct a home hazard hunt. Many items and conditions around the home can present fire hazards. Taking time to look for and eliminate hazards will reduce the risk.
- Inspect wood stoves and chimneys annually. Burning wood leaves creosote deposits—the substances left over in the chimney after a fire. These deposits are

flammable in the firebox, flue, and chimney, and trained professions should remove them to minimize the risk of fire.

- Purchase heaters only if they have been laboratory tested and approved. Follow the manufacturer's directions for use. Keep blankets, clothing, curtains, furniture, and any other flammable items at least three feet away from heat sources. Plug heaters directly into a wall socket and unplug them when they are not in use.
- Keep matches and lighters away from children. Fascinated by fire, children will play with matches and lighters if they are available.
- Check electrical wiring, and replace frayed extension cords, exposed wires, or loose plugs. Ensure all outlets have cover plates and avoid overloading outlets or extension cords.
- Keep combustible materials away from the stove, including towels, clothing, curtains, bags, boxes, and other appliances. Combustible materials near stoves can catch fire quickly while the cook's attention is elsewhere.

These are only a few suggestions for preventing fires. CERT Basic Training Unit 6, Fire Safety, provides additional suggestions, including how to select and use fire extinguishers.

### *During a Home Fire*

If you see a fire or hear the smoke alarm, you should:

- Yell, "Fire!" several times and exit quickly. Never use an elevator when escaping a fire. Other points to remember include the following:
  - If escaping through smoke, crawl low, under the smoke.
  - If escaping through a closed door, look first at the door. If air is being sucked under the door or smoke is seeping out the top of the door, do not open the door.
  - If you do not see air sucking or smoke escaping, feel the door with the back of your hand, as well as the space between the door and its frame and the doorknob before opening the door. Never open a door that feels hot.
- Go to the agreed upon meeting place, then call the fire department as quickly as possible.
  - Gathering at the meeting place first will quickly indicate who is outside and allow family members to advise firefighters immediately when they arrive.

If smoke, heat, or flames block all exit routes, you should stay in the room with the door closed.

- Stop up areas where smoke could come in using wet towels, sheets, or clothes under doors and in vents.
- Call the fire department and tell them where you are—even if the fire department has already been called.

- Open windows slightly at top and bottom to allow smoke to exit and fresh air to enter the room.
- Stay low and near a window to breathe fresh air.
- Hang or wave a bright-colored or white cloth at the window to signal the fire department when they arrive.

### ***After a Home Fire***

Take precautions and protect yourself when returning home after a fire:

- Extinguish sparks or embers that could reignite the fire.
- Do not touch electrical equipment if it is wet or if you are standing in water.
- Turn off electricity at the main breaker or fuse box to prevent electric shock.
- Turn off electricity if you smell burning insulation or see damaged wires.

If you are unfamiliar with your home's electrical systems, contact the local power company or a qualified electrician for assistance.

## **Wildfires**

### ***Wildfire Preparedness***

Some of the strategies for wildfire preparedness are the same as for fires in the home and developing a family fire escape plan will be helpful for wildfires as well as fires in the home. In the case of wildfires, some additional prevention actions are required:

- Whenever possible, use fire-resistant materials for construction, renovation, or repairs and practice good maintenance. Use Class A or Class B fire resistant roof material, fire-retardant treated wood, enclose or box in openings such as eaves and decks, cover other spaces with fine wire mesh, install tempered safety glass, use fireproof shutters. Establish an outdoor source for water. These practices will help protect your property and better protect you if a wildfire traps you in your building.
- Never leave outdoor fires unattended. Fully extinguish any outdoor fires (e.g., campfires, grills, and outdoor fireplaces), and ensure they are cold to the touch before leaving the area. Dispose of charcoal briquettes and fireplace ashes properly.
- Keep gas grills and propane tanks at least 15 feet away from any structure. Clear an area 15 feet around the grill. Do not use the grill during potentially dangerous fire weather conditions. Always have a fire extinguisher or hose nearby.
- Store combustible or flammable materials in approved safety containers away from the house.
- Do not use welders or any equipment that creates sparks outside on dry, windy days.

- Do not park vehicles in tall, dry grass if authorities have issued a fire weather watch or fire weather/red flag warning. Exhaust systems are very hot and can ignite dry grass.
- Use proper building and landscape design.
- Set up three defensible zones where possible. Wildland fire experts recommend clearing flammable vegetation to a distance of at least 30 feet around the home, an area commonly referred to as a “defensible space” or a “safety zone.”
- Work with neighbors to extend the individual defensible zones to include the neighborhood.
- Follow all burning laws. Never leave a fire, even a cigarette, unattended.
- Learn more about how you and your family can prevent a wildfire by using fire and equipment responsibly at [www.SmokeyBear.com](http://www.SmokeyBear.com).

Despite our best efforts, wildfires will still occur. Current federal guidance is to evacuate wildfire areas whenever possible and the evacuation may come long before a wildfire comes close to your property. If a wildfire is approaching your home or business, authorities will never advise you to stay and fight the fire.

### *During a Wildfire*

If a wildfire emergency has begun in your area:

- Listen for emergency information on radio or television stations or the Emergency Alert System (EAS).
- If advised to evacuate, do so immediately. Delay increases the risk of being trapped by the fire and can interfere with fire department response.
- While your family’s safety is most important, if there is time before you leave, there are things you can do to help firefighters. This includes: closing up the house and leaving lights on for visibility, moving flammable materials to the center of the home, away from windows; leaving hoses connected to a water source so they are available for the fire department.
- Use a National Institute for Occupational Safety and Health (NIOSH)-certified respirator (e.g., N-95) to help protect against particulate inhalation.

### *After a Wildfire*

Use caution when reentering the area or your home after a wildfire. Be aware hazards may still exist, including hot spots, which can flare up without warning. Also, be sure to take precautions and protect yourself upon return and while cleaning the area after a fire.

- Wear protective clothing, including a long-sleeved shirt, long pants, work gloves, and sturdy, thick-soled shoes during clean up. These will protect you from further injury from broken glass, exposed nails, or other objects.

- Check the stability of trees and poles in the area. They may have lost stability because of fire damage. Also, identify and mark ash pits (created by burned trees and stumps). Falling into a hot ash pit can cause serious burns.
- Do not attempt to remove heavy debris by yourself.
- Upon returning home:
  - Inspect the roof immediately and extinguish sparks or embers that could reignite the fire.
  - Do not touch electrical equipment if it is wet or if you are standing in water.
  - Turn off electricity at the main breaker or fuse box to prevent electric shock.
  - Turn off electricity if you smell burning insulation or see damaged wires.
  - If you are unfamiliar with your home’s electrical systems, contact the local power company or a qualified electrician for assistance.

[This page intentionally left blank]

[This page intentionally left blank]



# CERT Hazard Annex: Floods

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

Flooding is the most common natural disaster in the United States. According to a 2018 report by The Pew Charitable Trusts, over 73 percent of declared Federal disasters from 2008 to 2017 were flood-related. A flood is a general and temporary condition of partial or complete inundation of normally dry land. Flood effects can be local, impacting a neighborhood or community. Effects can also be very large, affecting entire river basins and multiple states. While some floods develop slowly over a period of days, some may develop quickly and cause flash floods. Floods are frequent and costly natural disasters in terms of human hardship and economic loss.

Floods have many causes, including:

- Heavy rain, which may occur over several days or as intense rainfall over a short period.
- Coastal storm surge, which is a rise in water generated by a storm that increases water levels above normal tides.
- Spring snowmelt, ice, or debris jams that cause a river or stream to overflow its banks and flood the surrounding area.
- Dam and levee failure. While dam and levee failure occur relatively infrequently, it can be a risk especially with prolonged rainfall. An example is the flooding of New Orleans during Hurricane Katrina in 2005.
- Low absorption or no soil percolation due to multiple causes including natural geology and the built environment. Areas with rocky geology cannot absorb rainfall or snowmelt. The result can be flooding with little or no warning. As communities continue to convert land from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization increases runoff as much as two to six times over what would occur on natural terrain.
- Business and residential growth in flood areas destroys natural absorption of runoff due to impermeable surfaces. Homes and businesses located on floodplains are at significantly greater risk for serious flood damage.
- In or downstream from areas impacted by wildfire. Wildfires dramatically change landscape and ground conditions, which can lead to increased risk of flooding due to heavy rains, flash flooding, and mudflows.

In addition, flash flooding may occur. A flash flood is defined as a flood that begins within six hours (and often within three hours) of heavy rainfall. Flash floods can be caused by several things but is most often due to extremely heavy rainfall from thunderstorms.

## Flood Impacts

Learn whether you live, work, or travel through areas that are prone to flooding and understand the kind of flooding that may occur. Your best protection is to plan so you can avoid floodwaters.

Depending on where you are, and the impact and the warning time of flooding, your best protection may be to leave the area in a planned evacuation. Other options include getting to higher ground or to a higher floor, or to stay where you are away from potential localized flooding.

It is particularly important to be prepared for flooding if you live inside a special flood hazard area (SFHA—a land area subject to a one percent or greater chance of flooding in any given year), in a low-lying area near a body of water, or in an area prone to flash flooding. Every major drainage basin in the United States has a floodplain surrounding it.

Most areas of the United States are subject to some degree of flooding. To find your community's flood map and other products, visit FEMA's Map Service Center at <https://msc.fema.gov/portal/home>.

Floodplain areas are widespread along the Mississippi River, the central valley of California, the South Atlantic, the Gulf Coast, and the Missouri River and Arkansas River basins.

The costs associated with flooding are increasing as more development occurs in coastal areas and floodplains. Each year, flood losses and damages reach into the billions of dollars.

From 2003 to 2012, total flood insurance claims averaged nearly \$4 billion per year. Since 1978, the National Flood Insurance Program (NFIP) has paid more than \$48.1 billion for flood insurance claims and related costs (as of July 2013). The annual average lives lost due to flooding is about 100 per year in the United States.

In 2017, heavy rainfall from Hurricane Harvey led to catastrophic flooding throughout the Houston metropolitan area. The storm resulted in 107 fatalities and is estimated to have cost \$125 billion dollars in damage.

## Flood Preparedness

### *Flood Awareness*

Once the National Weather Service (NWS) issues a flood or flash flood watch or warning, local radio and television stations and the NOAA Weather Radio will report on the risk of flooding using the Emergency Alert System (EAS). There is no advanced warning for some flash flooding.

Flood watches alert the public that flooding is possible within the watch area. If you are in a watch area, you should:

- Keep informed; and
- Be ready to act if authorities upgrade the watch to a warning or if you see flooding.

There are two types of flood warnings:

- Authorities issue a **flood warning** when flooding is imminent or occurring.

- Authorities issue a **flash-flood warning** when flash flooding is imminent or is occurring.

Whether the NWS issues a flood warning or a flash-flood warning, persons within the warning area should take precautions immediately. Both watches and warnings will include protective measures that the NWS recommends.

It is important to:

- Know the flood risk in the area, including the elevation above flood stage and the history of flooding in the area.
- Plan for evacuation, getting to high ground or a high floor, or for sheltering in place, depending upon the threat and your elevation.
- Prepare a flood evacuation plan and practice the route. Include your community's local evacuation plan as part of your evacuation planning. Be aware of which roads become flooded and which remain passable. The entire family should know where to go if they must evacuate.
- Learn and practice driving the local flood evacuation routes, which provide the best means of escaping floodwaters.
- Obtain flood insurance if living in a floodplain (Special Flood Hazard Area). Homeowner's policies do not cover flooding! Check with the city or county government to review the Flood Insurance Rate Maps (FIRMs). Then check with an insurance agent to obtain coverage under the National Flood Insurance Program (NFIP).
- Keep important documents in a sealed waterproof and fireproof container. Most documents can be replaced, but some are more difficult to replace. Protecting them in a waterproof and fireproof container is a good plan of action. Making password protected digital copies to keep with a relative or trusted friend in another location is also a good strategy. Use the critical document checklist at [www.fema.gov/media-library/assets/documents/94715](http://www.fema.gov/media-library/assets/documents/94715) or [www.Ready.gov](http://www.Ready.gov).
- Check emergency messages using a portable radio. NWS and local officials update watches and warnings as necessary. Listen often for up-to-date information.

The best way to protect your property from flood damage is to avoid building in a floodplain unless you elevate your home and take other flood protection measures. If an existing home is in a floodplain, some steps can help reduce potential damage:

- Keep gutters and drains free from debris.
- Install check valves in plumbing to prevent floodwater from backing up into the drains of the home.
- Install sump pumps with battery backup.
- Waterproof the basement floor and walls to prevent seepage through cracks.

- Move furniture and other items to a higher level. Even if the main floor of the home is flood-damaged, moving furniture and other items to a higher level will reduce flood losses.
- Elevate the furnace, water heater, and electric panel to at least one foot above the level of the floodplain (called the Base Flood Elevation). In some areas, elevating these appliances and utilities may mean relocating them to a higher floor or even to the attic.

In some cases, even these suggestions will not be enough to prevent serious damage from flooding. Those who live in floodplains should consult building professionals if they think they need more elaborate mitigation measures.

## During a Flood

- If told to evacuate, do so immediately.
- Never walk, swim, or drive through floodwaters. Floodwaters move swiftly, may carry debris that can cause injuries, and hide damaged roads and the actual depth of the water.
- Remember that 12 inches of moving water can wash a small car away and 6 inches of fast-moving water can knock an adult off his or her feet. **Turn Around, Don't Drown®**.
- If in a vehicle and floodwater is blocking your evacuation route, turn around safely and go to a building on high ground. If swift moving water traps your vehicle, stay in the vehicle. If water is rising inside the vehicle, seek refuge on the roof.
- If trapped in a building, go to the highest level of the building. Avoid basements and lower floors, but do not climb into a closed attic as you may become trapped by rising floodwater. Go onto your roof only if necessary. Signal for help.
- If outdoors, move to higher ground. Stay out of areas subject to flooding, including streams, drainage channels, canyons, and even dips in the road.
- Stay off bridges over fast-moving water. Fast-moving water can undermine and wash bridges away without warning. Flood events can compromise the safety of bridges susceptible to scour. Scour is the erosion of the streambed material caused by flowing water. Scour caused by floodwaters can remove large amounts of foundation material from under the footings of a bridge and cause the bridge to become unstable.
- Keep away from waterways. If you are driving and come upon rapidly rising waters, turn around and find another route. Move to higher ground away from rivers, streams, and creeks.
- Pay attention to barricades. Local responders place barricades to warn of flooding ahead or to direct traffic safely out of the area. Never drive around barricades.

## After a Flood

The best thing to do is listen to Emergency Alert System (EAS) information to determine whether it is safe to return and if there are special instructions to follow (e.g., boiling water advisory).

Take these precautions after a flood:

- Stay out of flooded areas. Flooded areas remain unsafe. Entering a flooded area places you—and the individuals who may need to rescue you—at risk.
- Reserve the telephone for emergencies only. Telecommunication lines (both landline and cellular) will be busy following a flood. A nonemergency call may prevent an emergency call from getting through. It is best not to use the phone unless necessary. Use email, text messages, and social media to communicate with family and friends.
- Avoid driving, except in emergencies. Reserve the roads for those who must evacuate and for emergency vehicles.
- Wait for authorities to issue an all-clear message that it is safe to return to evacuated areas.
- Be aware that snakes and other animals may be in your house and under outside debris in the aftermath of a flood. Wear heavy gloves and boots and be careful during clean up.
- Listen for news reports to learn whether the community's water supply is safe to drink.
- Avoid wading in floodwater. Oil, gasoline, or sewage may have contaminated it and it may hide dangerous debris, damaged roads, and deeper-than-expected water. Before walking through debris, use a stick to check for hidden dangers.
- Watch for dangerous debris (e.g., broken glass, metal fragments), dead animals, or venomous snakes that may be in floodwaters. Underground or downed power lines may electrically charge the water.
- Use a generator or other gasoline-powered machinery ONLY outdoors and away from windows so fumes do not get inside. Carbon monoxide exhaust can be deadly. Improper generator/electrical hookups can back feed power into power company lines with the risk of electrocuting linemen.
- Do not touch electrical equipment if it is wet or if you are standing in water. If it is safe to do so, turn off electricity at the main breaker or fuse box to prevent electric shock. If the area around the service equipment is wet or the service equipment itself is wet, have a qualified professional address the situation. Turn off electricity if you smell hot insulation or see damaged wires. If you are unfamiliar with your home's electrical systems, contact the local power company or a qualified electrician for assistance.
- Seek professional review or inspection of structures and utilities before entering buildings that have been flooded.

- Use extreme caution around debris. Do not attempt to remove heavy debris by yourself.
- Wear protective clothing during clean-up to protect against further injury from broken glass, exposed nails, or other objects. Clothing may include: long sleeved shirt, long pants, work gloves, and sturdy, thick-soled shoes.
- Use appropriate personal protective equipment to avoid injury from possible exposure to mold and bacteria. Equipment may include: gloves, goggles, rubber boots, and a N-95 mask.

[This page intentionally left blank]

[This page intentionally left blank]

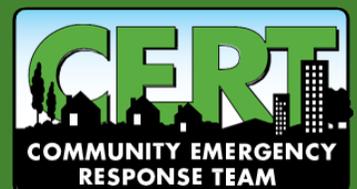


# CERT Hazard Annex: Hurricane

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

The Hurricane Hazard Annex to the CERT Basic Training course provides a high-level overview of hazard-specific information so communities that face this hazard are better able to prepare.

Hurricanes are massive storm systems that form over warm ocean waters. Threats from hurricanes (also called typhoons and cyclones) include high winds, heavy rainfall, storm surge, coastal and inland flooding, rip currents, tornadoes, and landslides.

Between 1900 and 2017, over 9,000 people died from hurricanes in the United States. In 2005, Hurricane Katrina was responsible for more than 1,800 deaths in the United States. Another 117 deaths were attributed to Hurricane Sandy in 2012. And in 2017, Hurricanes Harvey and Irma were responsible for at least 100 deaths in the United States.

Hurricanes also cause tremendous damage to businesses, communities, and the Nation's critical infrastructure. The top 20 costliest hurricanes to hit the U.S. mainland between 1972 and 2010 each caused at least \$2 billion in damage. In 2017 alone, the damage caused by Hurricanes Harvey, Irma, and Maria totaled approximately \$265 billion.

Due to the deadly nature of hurricanes, as well as the large financial toll that these storms can take, preparation is essential for communities that could be in the path of a hurricane.

### Hurricanes vs. Coastal Storms

The National Hurricane Center defines a hurricane as a “tropical cyclone in which the maximum sustained surface wind (using the U.S. 1-minute average) is 64 knots (kt). This translates to approximately 74 mph or 119 kilometers per hour. The term hurricane is used for Northern Hemisphere tropical cyclones east of the International Dateline to the Greenwich Meridian. The term typhoon is used for Pacific tropical cyclones north of the Equator west of the International Dateline.”

The Atlantic hurricane season runs from June 1 to November 30, with the peak occurring between mid-August and late October. The Eastern Pacific hurricane season begins May 15 and ends November 30. Globally, September is the most active month and May is the least active month for hurricanes.

Hurricanes differ from coastal storms (e.g. nor'easters). Although coastal storms may have hurricane-force winds and may cause similar kinds and amounts of damage. They are not classified as hurricanes because they do not originate in the tropics. Coastal storms are most frequent and most intense from September through April.

### Hurricane Impacts

Powerful winds and storm surges can:

- Damage or destroy structures;
- Lift and move unstable structures and objects;

- Damage utility and sewage lines;
- Give rise to tornadoes;
- Cause coastal erosion;
- Cause flooding (inland and coastal);
- Threaten lives;
- Make roads impassable;
- Disrupt communication lines, including 9-1-1; and
- Overwhelm the capabilities of first responders.

The accompanying heavy rains can inundate coastal areas and inland communities, presenting another risk to life and property.

The United States ranks first in the number of annual hurricane impacts. Specifically:

- Between 1970 and 2018, hurricanes accounted for nearly 2,000 deaths in the United States.
- About 80 percent of direct hurricane fatalities in the United States since 1970 occurred outside of landfall counties, with most of these fatalities caused by inland flooding (all hurricanes 1970 – 2007, excluding Hurricane Katrina).
- Of the 4,586 flood fatalities reported in the United States from 1959 through 2005, researchers found that 64 percent (approximately 2,935) of fatalities occurred in vehicles or permanent structures. Of those deaths, 63 percent (approximately 1,849), occurred in vehicles.
- At least 23 percent of U.S. hurricane-related deaths from 1970 to 1999 occurred to people in, or attempting to abandon, their vehicles primarily on inland flooded roads.

### *Frequency of Hurricanes*

In the United States, 326 hurricanes made landfall between 1851 and 2017. Over one-third of these hurricanes (97) were classified as major hurricanes. Hurricanes have made landfall in Florida more than in any other state. The second most hurricane-affected state is Texas, but every state on the Gulf Coast and bordering the Atlantic Ocean is susceptible to damage caused by hurricanes, as are U.S. island possessions and territories of Puerto Rico, American Samoa, and Guam, which have been seriously affected by numerous tropical cyclones.

## Hurricane Facts

### *Saffir-Simpson Hurricane Scale*

Officials use the Saffir-Simpson Hurricane Scale, which measures wind speed, to classify hurricanes. **Table 6** below also includes the anticipated barometric pressure (in inches) and storm surge for each category of storm.

**Table 6: Hurricane Classifications**

Category	Barometric Pressure (Inches)	Windspeed (Miles Per Hour)	Storm Surge (Feet)
<b>I - Minimal</b>	More than 28.94	74 – 95	4 – 5
<b>II - Moderate</b>	28.91 – 28.50	96 – 110	6 – 8
<b>III - Extensive</b>	28.47 – 27.91	111 – 129	9 – 12
<b>IV - Extreme</b>	27.88 – 27.17	130 – 156	13 – 18
<b>V - Catastrophic</b>	Less Than 27.17	More Than 157	More than 18

## Hurricane Preparedness

Many people do not realize the threat that hurricanes can present—even if they live in hurricane-prone areas—because they have not experienced a major hurricane.

It is critically important to get timely notifications of approaching hurricanes.

- Learn how to obtain alerts and warnings in advance. These include watches and warnings for high winds, storm surge, flooding (e.g., flash flooding, coastal flooding, river flooding), thunderstorms, and tornadoes.
- Consider buying a NOAA Weather Radio All Hazards receiver, which receives broadcast alerts directly from the National Weather Service.
- Learn the meaning of Advisory, Watch, and Warning.
- Take immediate action upon receiving a hurricane watch or warning for your local area to minimize the loss of life and property during hurricanes and tropical storms.
- Understand various methods for communication in case power is lost.

It is important, whether you live inland or along the coast, for you to learn whether you live, work, or travel through areas that are prone to flooding and learn the kind of flooding that may occur. Your best protection is to plan so that you can avoid floodwaters during and after a hurricane or coastal storm.

Hurricanes and coastal storms have significant impact on inland regions. Seventy-nine percent of the hurricane-related fresh-water drowning fatalities occur in inland counties. Even though hurricanes weaken significantly in wind strength after making landfall, 47 percent of the hurricane-related wind deaths also occur in inland counties.

It is particularly important to be prepared for flooding, whether inland or along the coast, if you live inside the special flood hazard area (SFHA) and/or in an area prone to flash flooding.

There are certain preparations for people who live in high-risk areas of a hurricane or coastal storm before one occurs:

- **Know the risk and evacuation routes.** Be aware of the risk and know how to get out of the area as quickly as possible. To learn about the projected flooding risk to your property, visit <https://msc.fema.gov/portal>. Learn community hurricane evacuation plans (e.g., zones, routes, shelters) and how to find higher ground. Driving the evacuation routes to ensure familiarity before a storm and identifying shelter locations will make an evacuation run more smoothly. If authorities order a mandatory evacuation, evacuate immediately!
- **Develop an action plan.** When will you begin preparing your home for possible high winds and storm surge? How much time will it take you to evacuate, if necessary? Determine where you would go and figure out how you would get there if you need to evacuate. Always ensure that your vehicle is ready for evacuation by keeping it fueled and in good condition. Plan to evacuate if you receive a warning that flooding is imminent or has been observed in your area. Remember, flooding can occur in inland regions as well as coastal regions. While creating this plan, keep in mind any provisions that might be necessary to accommodate the elderly, infants, those with access or functional needs, as well as your pets.
- **Develop an emergency communications plan.** You may consider using a communication plan to check on the welfare of family members and vulnerable neighbors during a hurricane. Listen to public officials to receive information and expert advice as soon as available. Conserve battery power for emergency use and use phone lines only for emergency calls. Consider using alternate methods of communication (e.g., social media, text messaging) to reach family and/or friends.
- **Secure necessary supplies.** If you assemble your disaster supply kits as suggested in this unit, you will have everything you will need for hurricane and coastal storm preparedness. Keep in mind the needs of the elderly, infants, those with access and functional needs, and your pets. Ensure you have food, water, and other supplies in enough quantities to last at least 72 hours.
- **Check batteries.** Hurricanes and coastal storms often disrupt power and, depending on the extent of damage, authorities may not be able to restore it immediately. Check flashlights and portable radios to ensure they have fresh batteries. Replace old batteries and have extras available.
- **Flood proof your property, regardless of whether you live inland or along the coast.** Flood proofing can range from sandbagging your property and using a water sealer in areas that have basements, to elevating utilities and moving furniture to an upper floor. To learn about protecting your property, visit [www.floodsmart.com/](http://www.floodsmart.com/).
- **Fortify your house.** Consult [www.flash.org/peril\\_hurricanes.php](http://www.flash.org/peril_hurricanes.php) for information on protecting your windows, garage doors, roofs, and doors. Secure your roof, clear loose or clogged rain gutters, and trim large trees and shrubs away from the house.

- **Board up all windows and glass doors.** Strong winds can generate building failures when they produce forces that the buildings were not designed or constructed to withstand. Failures also occur when the breaching of a window or door creates a relatively large opening in the building where wind can enter and produce forces that buildings were not designed to withstand. To protect your home from wind and windborne debris, install manufactured wood or metal storm shutters or board up windows using plywood. Plywood shutters that you make yourself, if installed correctly, can offer a high level of protection from flying debris during a hurricane.
- **Secure any outdoor items** (e.g., barbecue grills, trashcans, and patio furniture) that the wind or water could pick up or wash away.
- **Shelter.** Consider staying with family or friends who live outside of the area that will be impacted, or if available, a hurricane safe room that has been designed for high-winds and protection from flood waters (e.g., FEMA safe room or International Code Council (ICC) 500 storm shelter).
- **Make sure your cell phone is charged.** Have a car cell phone charger available and cash on hand in case of a major power outage.
- **Listen to the Emergency Alert System (EAS) for local emergency information.** Local officials will have the most current emergency information about the storm (including watch and warning information from the National Weather Service) and they will provide information and instructions via the EAS.

You should know the details of your insurance plans, including deductibles and what is and is not included. Take photos and videos of your property at least once a year.

Standard insurance policies do not typically cover flooding, including storm surge flooding, but flood insurance is available for homeowners, renters, and business owners through the National Flood Insurance Program (<https://www.fema.gov/national-flood-insurance-program>). If you live in a high-risk area, be it inland or along the coast, you should purchase flood insurance and wind hazard insurance (if available), including coverage for wind damage. Participants should also consider reducing their insurance premium by retrofitting their home to resist wind-related damage, and/or by elevating your home to protect against flooding.

Depending on where you are, the impact and the warning time, your best protection may be either to leave the area in a planned evacuation, or to get to higher ground or to a higher floor, or to stay where you are indoors away from potential debris and localized flooding.

Evacuate if advised. If you are in an evacuation zone, LEAVE IMMEDIATELY. As CERT members, you set the example for your community.

If you are evacuating:

- **Determine where you will go.** Follow directions from local officials. Follow posted evacuation routes. Identify a house of a family member or friend who lives outside your local area, or a public shelter, where you will go if you evacuate. Keep in mind those with access and functional needs, the elderly, and your pets.

Pre-registration and approval at shelters is often required. Check with the shelter to determine what supplies you it will allow you to bring.

- **Leave as early as possible.** Best to leave before flooding and high winds hit your area.
- **For flash flooding, seek high ground or stay on high ground.**

If you are NOT in an evacuation zone and you decide to stay or if time does not allow you to evacuate:

- Follow the sheltering guidelines.
- Seek shelter in a FEMA safe room or ICC 500 storm shelter.
- If those are not available, take refuge in a small interior, windowless room, closet, or hallway on the lowest level above flood water levels.
- Secure outdoor items (e.g., patio furniture). Bring loose, lightweight objects inside that could become projectiles in high winds.
- If in a manufactured home or temporary structure, move to a sturdy building.
- If in an area prone to flooding, whether inland or along the coast, move to a location on higher ground before floodwaters or high winds prevent your ability to leave.
- Assist those with access and functional needs. For instance, a wheelchair-dependent person who lives in a high-rise apartment might be “shut-in” if the electricity goes out and the building’s elevator is inoperable. He/she will require food, water, and possibly medicine.

## During a Hurricane

- Monitor communications. Conserve battery power for emergency use, support recovery by reducing phone congestion and use phone lines only for emergency calls. Know alternate methods of communication. If you need to reach family and/or friends, use text messaging or social media.
- NEVER use a portable generator inside the home. Keep generators and other alternate power/heat sources outside, at least 20 feet away from windows and doors and protected from moisture; and NEVER try to power the house wiring by plugging a generator into a wall outlet.
- Stay indoors away from windows, skylights, and doors to protect against flying debris. If advised to evacuate, do so. However, do not assume that because authorities do not issue an evacuation order that the situation is safe. Even Category 1 hurricanes are dangerous. Stay indoors and listen to EAS for up-to-date information.
- If advised to take shelter, grab your emergency supply kit and take it to your shelter room (FEMA safe room, ICC 500 storm shelter, or a small, interior, windowless room). Stay inside the room and listen to EAS for additional instructions.

- For high winds, lie on the floor under a table or other sturdy object for greater protection from falling objects.
- If outside, safely move inside as quickly as possible.
- Avoid driving if possible. Wind gusts can cause a vehicle to overturn or deviate off course. Most accidents occur when the maximum gust wind speed is above 20 meters per second (m/s). Traffic movement should be restricted when wind gust speeds are greater than 17 – 20 m/s.
- Be aware of the “eye.” After the center of the hurricane (the eye) passes over, the storm will resume. Do not venture outside until emergency officials say it is safe. According to NOAA, the “eye” of a hurricane is a roughly circular area of comparatively light winds and fair weather found at the center of a severe tropical cyclone. There is little or no precipitation and sometimes blue sky or stars can be seen. However, it is important to remember that the storm is not over.
- Be alert for tornadoes. As noted by NOAA, tropical cyclones at landfall often provide the conditions necessary for tornado formation, especially on the hurricane’s right side (with respect to its forward motion). For the southern hemisphere, this would be a concern on the tropical cyclone's left side due to the reverse spin of southern hemisphere storms.
- Prepare for disruptions in services, such as water, power, gas, and other supplies.

### ***In case of flooding:***

- Do not walk, swim, or drive through floodwaters. Floodwaters move swiftly, may carry debris that can cause injuries, and can hide damaged roads and the actual depth of the water. Remember that 12 inches of moving water can wash a small car away and 6 inches of fast-moving water can knock an adult off his or her feet. **Turn Around Don’t Drown®.**
- If trapped in a building, go to the highest level of the building. Avoid basements and lower floors, but do not climb into a closed attic as rising floodwater may trap you. Go onto your roof only if necessary. Signal for help.
- If in a vehicle and floodwater is blocking your evacuation route, turn around safely and go to a building on high ground. If your vehicle is trapped in rapidly moving water, stay in the vehicle. If water is rising inside the vehicle, seek refuge on the roof.
- If outdoors, move to higher ground. Stay out of areas subject to flooding, including streams, drainage channels, canyons, and even dips in the road.
- Be aware that hazardous debris, such as oil, gasoline, chemicals, bacteria, and raw sewage may be present in floodwaters, as well as other hidden dangers such as underground or downed power lines. Roads and bridges may have weakened and could collapse under the weight of a car.

## After a Hurricane

- Do not re-enter the area until officials have declared it safe to do so. Re-entry to the area too soon may cause unnecessary risk—and may keep first responders and utility workers from doing their jobs.
- Use a flashlight to inspect for damage. Use extreme caution when entering damaged buildings; use a flashlight indoors. If you smell gas, or if your carbon monoxide alarm sounds, move to fresh air immediately, call for help from the fresh air location, and stay there until emergency personnel arrive to assist you. Have your utilities inspected by qualified professionals for damage to the electrical system, sewage, gas, and water lines.
- Wear protective clothing. Avoid potential dangers from hazard damages, debris, and contaminants during clean up. Use protective clothing such as safety goggles, work gloves, hard hats, and waterproof boots.
- Contact your insurance company. Take pictures to document your damage and file a claim as soon as possible. Do what you can to prevent further damage to your property (e.g., putting a tarp on a damaged roof), as insurance may not cover additional damage that occurs after the storm.
- **Turn Around Don't Drown®** Avoid walking or driving in floodwaters. Stay clear of moving water especially near rivers, streams, and drainage systems. Debris, oil, gasoline, chemicals, bacteria, and raw sewage may contaminate floodwater. Underground or downed power lines may also have electrically charged the water.
- Check on neighbors. Use extreme caution, especially around damaged buildings or floodwaters, when you are aiding the injured.
- Prepare for disruptions in services, such as water, power, gas, and other supplies.
- If you use a generator, take safety precautions. Follow proper directions for use and never use a generator indoors, including garages. Keep the generator at least 20 feet from any opening of anyone's home or business. Consult your local fire marshal for more information.
- Stay away from downed power lines. The only way to limit risk from downed power lines is to avoid them completely.
- Call for help, if necessary. If you smell gas or a fire, move to a fresh air location immediately and call for help from the fresh air location and stay there until emergency personnel arrive to assist you. Do not attempt to turn off the utilities yourself.
- Reserve the telephone for emergency use only. Telephone lines are prone to overload following a disaster or emergency. Reserving telephone use (both landline and cellular) for emergency use helps to ensure that those calls that must go through do so. If you need to reach family and/or friends, use text messaging or social media.

- Listen to EAS for updated information. Local officials will use EAS extensively to provide emergency information and instructions. Be sure to tune in often for updates.

[This page intentionally left blank]

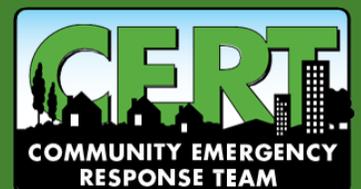


# CERT Hazard Annex: Landslide

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

Landslides are defined as the downslope movement of soil, rock, and organic materials under the effects of gravity, to include the landform that results from such movement. Landslides may be described by how they move: as falling, toppling, sliding, spreading, or flowing.

Some landslides move as slowly as seven feet per day or even a centimeter or two a year and cause damage gradually. Meanwhile, other landslides can move rapidly, striking with little or no warning at speeds of up to 55 mph for a mudflow and up to 100 mph for a rock slide.

### Landslide Impacts

Landslides occur in all 50 states. They cause an estimated 25 to 50 deaths in the United States each year.

Landslides generally strike in places where there is unstable rock, soil, or earth and can occur where there are steep slopes undercut by waves or water. Rainstorms, earthquakes, volcanic eruptions, stream erosion, human modifications of land or combinations of these triggers can cause a landslide. Landslides often accompany flooding. Large landslides rapidly sliding into coastal water or inland lakes may generate tsunamis.

### Landslide Facts

Landslides are described by both the material that is moving (rock, debris, earth) and how it is moving (fall, topple, slide, spread, flow). Some of the most common types of landslides include:

- **Debris flow:** A type of landslide that occurs often simultaneously with floods or when rapid snowmelt mobilizes soil on steep slopes and gullies, sending a fast-moving slurry of rocks, soil, mud, and other debris downhill.
- **Rockfall:** A rockfall is a detachment, fall, rolling, and bouncing of rock or ice fragments.
- **Mudflow:** A mudflow is a flowing mass of fine-grained earth material composed of up to 60 percent water resulting in a high degree of fluidity.

Other examples include rock topple, rock slide, earth fall, earth spread, debris fall, and debris topple. Please note that “mudslide” is an imprecise but popular term to describe a wide scope of events, ranging from debris-laden floods to landslides. The term “mudslide” is not technically correct.

### Landslide Preparedness

The best protective actions for a landslide are to be aware of the risks, know the signs, and avoid potential fall areas. The following are steps you can take to prepare for potential landslide activity.

- Learn about your landslide risk by contacting your local emergency management office for information on local landslide and debris flow hazards. The types of falls and slides and the potential impact vary by region, so it is important to learn about the types and signs of falls and slides common in your area.
- One of the most important steps that you can take is to become familiar with the landslide history in the area. You are at lower risk if you are in areas that:
  - Have not moved in the past;
  - Are relatively flat and away from sudden changes in slope; and
  - Are along ridge lines but set back from the tops of slopes.
- Research local land and mudslide evacuation plans. Determine where you would go and how you would get there if you needed to evacuate.
- Develop an emergency communications plan.
- If the area has had previous slides, seek a professional evaluation and recommendations.
- Obtain a ground assessment of your property, preferably before construction to avoid building in hazard risk areas. County or state geological experts, local planning departments, or departments of natural resources may have specific information on areas vulnerable to landslides.
- Avoid building near steep slopes, close to cliffs, or near drainage ways or stream channels.
- If construction has already occurred, consult an appropriate certified professional expert for advice on corrective measures you can take.
- Plant ground cover on slopes; build channels or deflection walls to direct the flow around buildings.
- Install flexible pipefittings to avoid gas or water leaks.
- Talk to your insurance agent. Flood insurance policies from the National Flood Insurance Program (NFIP) cover damage from mudflows. Damage from landslides and other earth movements is not.
- Monitor communications. Officials may issue alerts when conditions are present to produce a landslide. Stay inside and remain alert. Listen to radio/television for any weather update.
- If there are indicators for landslides or debris flows in your area and your location is in a potential path, obtain regular professional monitoring of the landslide risk in changing conditions. Consider evacuating if conditions allow it.
- Watch the patterns of storm-related drainage near your home and note the places where runoff water converges, increasing flow in channels. These are areas to avoid during a storm.

- If sheltering, avoid residential structures within close proximity to potential slide areas. Residential structures are unlikely to provide good shelter in the event of a fast-moving slide.
- Avoid camping in areas located under rock ledges, at the bases of steep slopes, or in ravines. Be wary of camping and hiking in drainages, narrow canyons, ravines (especially during stormy weather), or in an area of recently burned slopes.

Become familiar with signs of potential slide activity in the past or indicators of the potential for slide activity in the future. Some signs include:

- Springs, seeps, or saturated ground in areas that have not typically been wet;
- New cracks or unusual bulges in the ground, street pavements, or sidewalks;
- Soil moving away from foundations;
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house;
- Tilting or cracking of concrete floors and foundations;
- Broken water lines and other underground utilities;
- Leaning telephone poles, trees, retaining walls, or fences;
- Offset fence lines;
- Sunken or down-dropped roadbeds;
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content);
- Sudden decrease in creek water levels though rain is still falling or just recently stopped;
- Sticking doors and windows, and visible open spaces indicating crooked jambs and frames;
- A faint rumbling sound that increases in volume is noticeable as the landslide nears; and
- Unusual sounds, such as trees cracking or boulders knocking together, might indicate moving debris.

### **During a Landslide**

- Due to the potential for sudden, unexpected, and fast-moving slides, it is critical to be prepared so that you can act quickly during a landslide.
- Evacuate if there is enough warning to get out of the likely path before the slide starts. Once the slide starts, it may move too quickly to escape the slide unless you are already near the edge.

- Some of the deadliest landslides are those that occur at night when most building occupants are asleep. If there are indicators for slides or debris flows in your area and your location is in a potential path, evacuate in advance to avoid nighttime slides.
- Watch for flooding. Floods sometimes follow landslides because the same event (e.g., rainstorm, earthquake, volcanic eruption, stream erosion, and human modifications of land) may trigger both.

### After a Landslide

- Stay away from the slide area. There may be danger of additional slides.
- Check the building foundation, chimney, and surrounding land for damage, as this may help you assess the safety of the area.
  - Seek advice from a geotechnical expert for evaluating landslide hazards, even after a landslide event. A professional will be able to advise you of the best ways to prevent or reduce landslide risk, without creating further hazard.
- Watch for flooding. Floods sometimes follow landslides because they may both be started by the same event (such as episodes of prolonged rainfall).

[This page intentionally left blank]

[This page intentionally left blank]



# CERT Hazard Annex: Nuclear Emergencies

Participant Manual



FEMA



[This page intentionally left blank]

## **INTRODUCTION**

### **What is Radiation?**

Everyone is exposed daily to radiation from many sources, including the sun and the Earth. Radiation is the energy given off by unstable atoms. Atoms are some of the smallest building blocks of everything you see. Small amounts of radiation are present in food and water. Radiation is also released from manmade sources, such as x-ray machines, television sets, and microwave ovens.

The longer a person is exposed to radiation, the greater the risk of harm. A high exposure to radiation due to a nuclear power plant emergency or nuclear blast can cause serious illness or death.

In the event of a nuclear emergency, the area affected is determined by:

- The amount of radiation released;
- Wind direction and speed; and
- Weather conditions, like temperature and precipitation.

Knowing the basics of radiation is the first step to understanding the risks and staying safe during a nuclear emergency.

## **NUCLEAR POWER PLANT EMERGENCIES**

Nuclear power plants use heat from nuclear reactions to turn water to steam, which powers generators to produce electricity.

The danger from an accident at a nuclear power plant is exposure to radiation. This exposure could come from the accidental release of radioactive material, usually characterized by a plume (cloud-like) formation of radioactive gases and particles. An accident could result in dangerous levels of radiation that could affect the health and safety of the public living near the nuclear power plant.

The construction and operation of nuclear power plants are closely monitored and regulated by the Nuclear Regulatory Commission (NRC). The Federal Emergency Management Agency (FEMA) also regulates emergency planning requirements for nuclear power plants. However, accidents at these plants are possible.

### **Hazards of Nuclear Power Plant Emergencies**

Major hazards to people near a radiation plume include:

- Exposure of the body to the plume and particles deposited on the ground;
- Inhalation of radioactive particles; and
- Ingestion of radioactive particles.

If a nuclear power plant accidentally released radioactive material, local authorities will:

- Activate warning sirens or another alert method; and

- Provide instructions through the Emergency Alert System (EAS) on local television and radio stations.

### *Emergency Planning Zones*

Local and State governments, Federal agencies, and the electric utilities have emergency response plans in the event of a nuclear power plant emergency. The plans define two Emergency Planning Zones (EPZs):

- One EPZ covers an area within a 10-mile radius of the plant where people may be harmed by direct radiation exposure.
- The other EPZ covers a larger area, usually up to a 50-mile radius from the plant, where radioactive materials can contaminate water supplies, food crops, and livestock.

### *Minimizing Radiation Exposure*

Exposure can be minimized by:

- **Time:** Limit your time exposed to radioactive material. Most radioactivity loses its strength quickly. In a nuclear power plant accident, local authorities monitor radiation levels to determine when the threat has passed.
- **Distance:** The more distance between you and the source of the radiation, the better. In a serious nuclear power plant accident, local authorities will call for an evacuation to increase the distance between you and the radiation. Evacuation also reduces the time of exposure.
- **Shielding:** The more heavy and dense material between you and the source of the radiation, the better. This is why local authorities could advise you to remain indoors if an accident occurs. In some cases, the walls in your home would be sufficient shielding to protect you.

### **Nuclear Emergency Terms**

It is important to know the following terms used to describe nuclear emergencies:

- **Notification of Unusual Event:** A small problem has occurred at the plant. No radiation material release is expected. Federal, State, and county officials will be told right away. No action on your part will be necessary.
- **Alert:** A small problem has occurred. Small amounts of radiation material could leak inside the plant. This will not affect you and you should not have to do anything.
- **Site Area Emergency:** A more serious problem has occurred. Small amounts of radiation material could leak from the plant. If necessary, State and county officials will act to assure public safety. Area sirens may be sounded. Listen to your radio or television for safety information.
- **General Emergency:** This is the most serious type of emergency. Radiation material could leak outside the plant and off the plant site. Sirens will sound.

Tune to local radio or television stations for emergency information. State and county officials will act to protect the public. Follow instructions promptly.

### During a Nuclear Power Plant Emergency

- Listen to the warning. Not all incidents result in the release of radiation. The incident could be contained inside the plant and pose no danger to the public.
- Stay tuned to local radio or television. Local authorities will provide specific information and instructions.
  - The advice given will depend on the nature of the emergency, how quickly it is developing, and how much radiation, if any, is likely to be released.
  - Local instructions should be followed, not advice given on national broadcasts or in books.
  - Review the public information materials that you received from the power company or government officials before the event.
- Evacuate only if you are advised to do so.
  - Close and lock doors and windows.
  - If driving, keep car windows and vents closed. Use recirculated air. Most vehicles have a button labeled with the image to the right that switches between drawing air from outside the car to recirculating air in the car.
  - Listen to the radio for evacuation routes and other instructions.
  - If you are not told to evacuate, shelter in place.
  - Close doors and windows.
  - Turn off the air-conditioner, ventilation fans, furnace, and other air intakes.
  - Go to a basement or other underground area if possible.
  - Always keep a battery-powered radio with you.
- If time permits, shelter livestock and give them stored feed.
- Do not use the telephone unless it is absolutely necessary. Lines will be needed for emergency calls.
- If you suspect exposure, shower thoroughly.
  - Change clothes and shoes.
  - Put exposed clothing in a plastic bag.
  - Seal the bag and place it out of the way.
- Eat food that was stored in sealed containers, in the refrigerator or freezer, or in a pantry or drawer away from radioactive material.



## After a Nuclear Power Plant Emergency

- If you evacuated, return home only when local authorities say that it safe to do so.
- If sheltered in place, remain inside until local authorities say that it is safe.
- Get immediate medical treatment for any unusual symptoms, such as the rapid onset of vomiting which may be related to radiation exposure.
- Put food in covered containers or in the refrigerator. Food not previously covered should be washed thoroughly before being put in container.

## NUCLEAR EXPLOSIONS

Nuclear explosions can cause significant damage and casualties from blast, heat, and radiation but you can keep your family safe by knowing what to do and being prepared if it occurs. A nuclear weapon is a device that uses a nuclear reaction to create an explosion. Nuclear devices may range from a small portable device carried by an individual to a larger weapon carried by a missile.

Warning times may vary before a nuclear explosion. There may be several minutes of warning or no warning at all.

- **Attack with warning:** A warning may be issued a few minutes before a nuclear detonation. If there is a warning, get inside immediately and move away from windows. Do not look outside as a bright detonation flash may cause temporary blindness. Stay indoors and away from windows for a full minute after a bright flash.
- **Attack without warning:** A blinding flash of light could indicate the detonation of a nuclear weapon. If this occurs, duck down immediately for at least a minute to protect yourself from possible flying debris.

## Hazards

- Blast waves can cause death, injury, and damage to structures several miles from the explosion.
- Fire and heat can cause death, burn injuries, and damage to structures several miles from the explosion.
- A bright flash from the explosion can cause temporary blindness for up to a minute.
- Radiation can damage cells of the body. Significant exposure can cause radiation sickness.
- Fallout is visible dirt and debris raining down from several miles up that is radioactive and can cause sickness to those who are outside.

**Fallout** is most dangerous when it gives off the highest levels of radiation in the first few hours after the explosion. It takes time for fallout to arrive back to ground level, often

more than 15 minutes for areas outside of the immediate blast zones. This may be enough time to prevent significant radiation exposure by following these steps:

### ***Get Inside***

- Get inside the nearest building. Brick or concrete structures are best for blocking radiation.
- Go to the basement or middle of the building. Stay away from outer walls, windows, and the roof.
- Remove contaminated clothing and wipe off or wash unprotected skin if you were outside after the fallout arrived.

### ***Stay Inside***

- Stay inside for 24 hours unless local authorities provide other instructions.
- Families separated from loved ones and pets should stay where they are, inside and safe. Reunite later to avoid exposure to dangerous radiation.

### ***Stay Tuned***

- Tune in to any media available for official information, such as when it is safe to exit and where you should go upon exiting.
- Cell phone, text messaging, television, and internet services may be disrupted or unavailable.
- Battery-operated and hand crank radios may function after a nuclear detonation.

## **What to do Now: Prepare**

- Identify shelter locations. Identify the best shelter location where you spend a lot of time, such as home, work, and school. The best locations are underground and in the middle of larger buildings.
- Outdoor areas, vehicles, and mobile homes do not provide adequate shelter. Look for basements or the center of large multistory buildings.
- Make sure you have an Emergency Supply Kit stored at places you frequent and serve as a shelter. It should include bottled water, packaged foods, emergency medicines, a hand-crank or battery-powered radio to get information in case power is out, a flashlight, and extra batteries for essential items. If possible, store supplies to last for three or more days.

## **What to do During: Survive**

- If warned of an imminent attack, immediately get inside the nearest safe building and move away from windows. This will help provide protection from the blast, heat, and radiation of the explosion.

- If outdoors when an explosion occurs, take cover from the blast behind anything that might offer protection. Lie face down to protect exposed skin from the heat and flying debris. If in a vehicle, stop safely and duck down within the vehicle.
- After the shock wave passes, get inside the nearest, best shelter location for protection from potential fallout. You will have up to 15 minutes to find adequate shelter.
- Get inside before the fallout arrives. The highest outdoor radiation levels from fallout occur immediately after the fallout arrives and then decrease with time.
- Stay tuned for updated instructions from emergency response officials. If advised to evacuate, listen for information about routes, shelters, and procedures.
- If you have evacuated, do not return until officials say it is safe to do so.

### What to do After: Be Safe

- If you were outside after the fallout arrived, take the following actions immediately after finding shelter:
  - Remove your outer layer of contaminated clothing.
  - Take a shower or wash with soap and water to remove fallout from any skin or hair that was not covered. If you cannot wash or shower, use a clean wet cloth to wipe any skin or hair that was not covered.
  - Clean any pets that were outside after the fallout arrived. Don an outer layer of clothing, gloves, and respiratory protection (like a dust mask), and gently brush your pet's coat to remove any fallout particles. Next, wash your pet with soap and water, if available.
  - It is safe to eat or drink packaged food items or items that were inside a building. Do not consume food or liquids that were uncovered outdoors and may be contaminated by fallout.
  - If you are sick or injured, listen for instructions on how and where to get medical attention when authorities tell you it is safe to go outside.

### Take an Active Role in Your Safety

- Download the FEMA app to get more information about preparing for a nuclear explosion.
- Go to Ready.gov: <https://www.ready.gov/nuclear-blast>
- Go to the Centers for Disease Control: <https://emergency.cdc.gov/radiation>
- Go to Health & Human Services:  
<https://www.remm.nlm.gov/nuclearexplosion.htm>

[This page intentionally left blank]

[This page intentionally left blank]



# CERT Hazard Annex: Thunderstorms

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

All thunderstorms and lightning are dangerous. Many also include heavy rains that cause flooding and flash flooding. The National Weather Service (NWS) defines a “severe” thunderstorm as one that:

- Produces hail at least an inch in diameter;
- Has winds of 58 mph or greater; and/or
- Produces a tornado.

Thunderstorms may occur individually, in clusters, or in lines. Some of the most severe weather occurs when a single thunderstorm affects one location for an extended time.

### Thunderstorm Impacts

The risks associated with thunderstorms include the following:

- **Lightning.** Both lightning fatalities and injuries have been on the decline for more than 50 years in the United States; however, lightning is still a major cause of death and injury among natural hazards. According to NOAA’s lightning fatality database, an average of 31 lightning deaths occurred in the United States each year from 2006 – 2015. An average of 182 lightning injuries occurred in the United States during the same period.
  - Lightning often strikes outside areas of heavy rain and can occur as far as 10 miles away from any rainfall.
  - You are in danger from lightning if you can hear thunder. If you hear thunder, lightning is close enough to strike. When you hear thunder, move immediately to shelter.
  - The NWS does not issue lightning warnings. The designation of a “severe thunderstorm” that results in a warning is related to factors other than lightning (damaging wind, large hail) and lightning is present in all thunderstorms.
- **Flash floods and other flooding.** Heavy rain from thunderstorms can cause flash flooding and river flooding. Flash floods are the number one cause of death associated with thunderstorms.

Additional risks from severe thunderstorms include:

- **Hail.** Hail can be smaller than a tear or as large as a softball and can destroy automobiles, glass surfaces, roofs, plants, and crops. Pets and livestock are particularly vulnerable to hail.
- **Downbursts and straight-line winds.** Thunderstorms can produce winds as high as 150 mph, strong enough to flip cars, vans, and trucks. These winds can have disastrous effects on air travel.
- **Tornadoes.** Some thunderstorms may spawn tornadoes.

### *Severe Thunderstorm Watches and Warnings*

The NWS Storm Prediction Center issues watches and warnings of hazardous weather, including severe thunderstorms. Keep your NOAA Weather Radio handy!

- A watch is issued when the atmosphere is favorable for the development of severe thunderstorms. Citizens should be alert for approaching storms.
- A warning is issued when severe weather has been reported by spotters or indicated by radar. Warnings indicate imminent danger to life and property to those in the path of the storm.

### **Thunderstorm Preparedness**

Key steps in thunderstorm preparedness:

- Understand the risk. Thunderstorms can occur year-round and at any hour. Take time to learn about the severe thunderstorm risk in your area—including how often severe thunderstorms are accompanied by tornadoes.
- When thunderstorms are predicted, plan to be near sturdy shelter.
- Pay attention to warnings. Use a NOAA Weather Radio with a tone-alert feature or listen to local radio or television for Emergency Alert System (EAS) broadcasts. Learn the community's warning system and never ignore warnings.
- When thunder roars, go indoors!

You can also take measures to protect your property, including those measures required for high wind:

- Check for hazards in your yard. Bring outdoor furniture inside or otherwise secure it to keep it from blowing away. Remove any debris or loose items in your yard. Keep trees and shrubbery trimmed. Strong winds frequently break weak limbs and hurl them at great speed, causing damage or injury when they hit. Cut down trees that may be in danger of falling on a structure. Consider installing permanent shutters to cover windows. Shutters can be closed quickly and provide the safest protection for windows.
- Consider purchasing surge protectors for electronic equipment and appliances.

If the community is at high risk for thunderstorms, or if sections of the community are particularly vulnerable, suggest participants living in those areas purchase and install lightning protection systems, including lightning rods, to protect people and property from fire risk and associated lightning risk. Lightning detectors can also help protect you.

### **During a Thunderstorm**

During a thunderstorm, you should avoid:

- **The outdoors.** When thunder roars, go indoors! A sturdy building is the safest place to be during a thunderstorm. Avoid unprotected areas and unprotected shelters in open areas.

- **Water sources.** If boating or swimming, get to land and find a sturdy, grounded shelter or vehicle immediately. Stay away from bodies of water. If indoors, stay away from running water. Electricity from lightning can travel through plumbing.
- **The telephone.** Electricity from lightning can also travel through telephone landlines. Note that cell phones are considered safe to use indoors.

Electricity from lightning can enter a room through appliances. If possible, it may be a good idea to turn off or unplug air conditioning and other appliances. This can eliminate the risk of damage from surges that accompany lightning strikes near the home.

If caught outdoors in a thunderstorm, you should:

- Avoid water sources. Get out of pools or lakes. Get off the beach.
- Seek shelter in a substantial, permanent, enclosed structure. Avoid unprotected shelters, such as golf carts and baseball dugouts. Temporary shelters, such as gazebos, are also subject to blowing over in a strong wind and offer little protection from hail. Remember that isolated shelters in otherwise open areas are a target for lightning.
- If there are no permanent shelters within reach, take shelter in a car with metal top and sides. Do not take shelter in a convertible automobile. Keep all windows closed and do not touch anything that is metal.
- Stop driving if hailing. Pull safely to the side of the road, keeping a good distance from trees or other tall objects that could fall on the vehicle, and ensuring that the emergency flashers are on. Do not stop under bridges or overpasses, as doing so may create extremely dangerous traffic jams and potential for accidents.
- Avoid flooded roadways. Most flood fatalities are caused by people attempting to drive through high water. The depth of water is not always obvious. The roadbed may be washed out or rapidly rising water could stall the engine or engulf the vehicle.

### After a Thunderstorm

- Listen to EAS for updated information. Some areas may be inaccessible and there may be damage in others. Local EAS broadcasts will provide current information on continuing risks and protective measures to take.
- Avoid storm-damaged areas. These areas are not safe immediately following a thunderstorm. Entry may increase personal risk and interfere with professional responders.
- Watch for fallen power lines and trees and report them to the appropriate authorities immediately.

[This page intentionally left blank]



# CERT Hazard Annex: Tornado

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

Tornadoes are violently rotating columns of air that extend from a thunderstorm to the ground and are often—although not always—visible as a funnel cloud. Winds from tornadoes can exceed 200 mph. Lightning and hail are common in thunderstorms that produce tornadoes. Tornadoes may range in width from several hundred yards to a mile across.

About 1,200 tornadoes are reported nationwide in an average year. Tornadoes can happen any time of the year and any time of day. Between 1940 and 2015, tornadoes accounted for approximately 2,600 deaths in the United States, an average of about 34 people each year, although this varies widely from year to year. Tornadoes are responsible for hundreds of millions of dollars in damage annually.

### Tornado Impacts

Due to high wind velocity, tornadoes can:

- Rip trees apart;
- Destroy buildings;
- Uproot structures and objects;
- Turn debris and glass into deadly projectiles; and
- Overturn cars and mobile homes.

### Tornado Facts

While tornadoes have occurred in every state, they are most prevalent east of the Rocky Mountains.

Peak tornado season depends on the area, but generally, tornadoes occur most often in the spring and summer months. However, tornados can occur year-round. Tornadoes are most likely to occur between 4:00 p.m. and 9:00 p.m.

The population in tornado-prone areas is increasing because of more rapid urban development, which increases the likelihood of injuries and deaths.

### Enhanced Fujita Damage Scale

Officials measure tornado strength based on the Enhanced Fujita Wind Damage Scale, which correlates damage with wind speed measured in three-second gusts estimated at the point of damage. There are six wind damage levels on the scale, listed in **Table 7** below:

**Table 7: Enhanced Fujita Damage Scale**

Wind Damage Level	Wind Speed Level of Typical Observed Damage
<b>EFO</b>	<ul style="list-style-type: none"> <li>• Winds: 65 – 85 mph</li> <li>• <b>LIGHT:</b> Chimneys damaged, tree branches broken, and shallow-rooted trees toppled.</li> </ul>

Wind Damage Level	Wind Speed Level of Typical Observed Damage
EF1	<ul style="list-style-type: none"> <li>Winds: 86 – 110 mph</li> <li><b>MODERATE:</b> Roof surfaces peeled off, windows broken, tree trunks snapped, unanchored mobile homes overturned, and attached garages destroyed.</li> </ul>
EF2	<ul style="list-style-type: none"> <li>Winds: 111 – 135 mph</li> <li><b>CONSIDERABLE:</b> Roof structures damaged, mobile homes destroyed, debris becomes airborne (generating dangerous projectiles, or “windborne missiles”), and large trees snapped or uprooted.</li> </ul>
EF3	<ul style="list-style-type: none"> <li>Winds: 136 – 165 mph</li> <li><b>SEVERE:</b> Roofs and walls torn from structures, small buildings destroyed, non-reinforced masonry buildings destroyed, most trees in forest uprooted.</li> </ul>
EF4	<ul style="list-style-type: none"> <li>Winds: 166 – 200 mph</li> <li><b>DEVASTATING:</b> Well-constructed houses destroyed, structures lifted from foundations and blown some distance, cars blown some distance, and large debris becomes airborne.</li> </ul>
EF5	<ul style="list-style-type: none"> <li>Winds: Over 200 mph</li> <li><b>INCREDIBLE:</b> Strong frame houses lifted off foundations, reinforced concrete structures damaged, automobile-sized</li> </ul>

With the help of sophisticated radar and other measures, meteorologists are now able to predict when conditions favorable for tornado formation exist and are able to warn the public better.

### Tornado Preparedness

- Know the risk for tornadoes in the area. Although tornadoes occur throughout the United States, some areas are at higher risk than others.
- Identify potential shelter areas where family members can gather during a tornado.
- The best shelter from a tornado is in a safe room built to FEMA standards or a storm shelter built to ICC 500 standards. If a storm shelter or safe room is unavailable, the next best protection is provided by small, interior, and windowless rooms in a sturdy building on the lowest level, underground is best. Avoid rooms with large free-span roofs. Cover yourself using whatever is available, such as a coat or a blanket, and cover your head and neck with your arms.

- Manufactured structures are unsafe in a tornado. Fatality rates are significantly higher than sturdy buildings. Identify an alternative shelter prior to a tornado watch or warning.
- Learn the warning system that your community uses. Many areas use Emergency Alert System (EAS) to warn of imminent hazards. Within these areas, though, communities may have other warning systems for tornadoes, including sirens used to signal fires and other hazards. For those who live in communities that use sirens, it is critical to learn the siren warning tone to ensure recognition. In addition, when severe weather threatens, NOAA weather radio carries current information and instructions.
- Conduct periodic tornado drills with your family to ensure that all family members know what to do and where to go during a tornado emergency.

Occasionally tornadoes develop so rapidly that advance warning is not possible. Remain alert to signs of an approaching tornado. Be alert for these clues and take protective action, even if authorities do not issue a tornado warning.

- A rotating, funnel-shaped cloud that extends from a thunderstorm toward the ground may be visible.
- An approaching cloud of debris, especially at ground level, can mark the location of a tornado even if a funnel is not visible.
- A loud, roaring sound similar to a freight train.
- A strange quiet occurring within or shortly after a thunderstorm. The wind may die down and the air may become very still.
- Debris dropping from the sky.
- A change in color of the sky.

## During a Tornado

If authorities issue a tornado watch:

- Tune in to NOAA Weather Radio All Hazards, local radio, and television weather reports. Check alert notifications.
- Review where you will go for protection and discuss with those around you. Change your plans, if necessary, to make sure you will be able to get to a protective location quickly.
- Call anyone you know who may not be tuned-in or who may need assistance to reach a protective location.
- Charge your cell phone in case the power goes out.

If authorities issue a tornado warning:

- Go immediately to a FEMA safe room or ICC 500 storm shelter or a small, interior, windowless room or hallway on the lowest floor (underground is best), or to an identified Best Available Refuge Area.

- Take additional personal cover. Cover your head and neck with your arms and put as much shielding material (e.g., furniture, blankets) as you can around you.
- Listen to EAS or NOAA Weather Radio for current emergency information and instructions.

If you are driving and see a tornado, go to a nearby sturdy building and seek an area on the lowest level (underground is best), without windows. Do not stop under a freeway, overpass, or trees. Do not attempt to outrun a tornado in a vehicle. Protect your head and neck whether you are in a vehicle or outdoors. Cover your head and neck with your arms and cover your body as best you can, with a coat or blanket if possible.

### After a Tornado

Following a tornado, individuals should continue listening to EAS or NOAA weather radio for updated information and instructions. As with many other hazards, post-tornado actions include:

- If trapped, stay still and cover your mouth with a cloth or mask to avoid breathing dust. Try not to move the debris around you or stir up dust. Send a text, if possible, or bang on a pipe or wall or use a whistle instead of shouting so that you do not breathe in dust.
- Avoid fallen power lines or broken utility lines and immediately report those you see.
- Stay out of damaged areas until told that it is safe to enter.
- Stay out of damaged buildings.
- Turn off utilities, if necessary.
- Use text messaging or social media to communicate with family and friends. Telephones and cellular phone systems are often overwhelmed following a disaster, so use phones only for emergency calls.

**Table 8** below reviews some common myths about tornadoes and explains why each is not true.

**Table 8: Tornado Myths and Facts**

Myth	Fact
<b>Areas near lakes, rivers, and mountains are safe from tornadoes.</b>	No place is safe from tornadoes. A tornado near Yellowstone National Park left a path of destruction up and down a 10,000-foot mountain.
<b>The low pressure with a tornado causes buildings to explode as the tornado passes overhead.</b>	Violent winds and debris slamming into buildings cause most structural damage.
<b>Open windows before a tornado approaches to equalize pressure and minimize damage.</b>	Leave windows closed to minimize damage from flying debris and to keep the high wind out of the structure.

Myth	Fact
<b>If you are driving and see a tornado, you should drive at a right angle to the storm.</b>	The best thing to do is seek the best available shelter. Many people are injured or killed when they choose to stay in their vehicles.
<b>People caught in the open should seek shelter under highway overpasses.</b>	Do not seek shelter under highway overpasses or under bridges. If possible, take shelter in a sturdy, reinforced building.
<b>It is safe to take shelter in the bathroom, hallway, or closet of a mobile home.</b>	Mobile homes, or any manufactured structure, are not safe during a tornado. Seek sturdy shelter immediately. If you live in a mobile home, ensure you have a plan in place that identifies the closest sturdy buildings.
<b>Getting into a ditch is safer than staying in a car if caught outside during a tornado.</b>	<p>There is no single recommendation for what last-resort action to take if you cannot get to safe shelter. With new developments in automotive design, increases in the size and stability of newer vehicles, and safety glass, researchers are evaluating the relative minimal protection being in a vehicle versus taking cover outdoors in an area lower than the surrounding ground or road level (e.g., a ditch) provided there is no flooding.</p> <p>Whether in a vehicle or outdoors, cover your head and neck with your arms and cover your body as best you can, with a coat or blanket if possible. If you take cover in a vehicle, put the seatbelt on and try not to park under a freeway, road overpass, or trees. Do not attempt to outrun a tornado in a vehicle.</p>

[This page intentionally left blank]



# CERT Hazard Annex: Tsunami

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

A tsunami is a series of enormous ocean waves produced by earthquakes, underwater landslides, undersea volcanic eruptions, or large meteorite impacts in the ocean. They can travel at jet airliner speeds across oceans. The word “tsunami” is Japanese and means “harbor wave” because of the devastating effects these waves have had on low-lying Japanese coastal communities. Often, tsunamis are referred to incorrectly as tidal waves.

Since the beginning of the 19th Century, tsunamis have caused more than 700 deaths and have generated nearly \$2 billion in damage to U.S. coastal states and territories.

Most tsunamis are less than 10 feet high, but in extreme cases, they can exceed 100 feet.

A tsunami can strike anywhere along most of the U.S. coastline and its territories, but the risk is greatest to coasts that border the Pacific Ocean.

### Tsunami Impacts

Areas within a mile of the shoreline, areas less than 25-feet above sea level, and areas located along streams or rivers that feed into the ocean are at greater risk. A tsunami can occur during any season of the year and at any time—day or night.

They can cause:

- Flooding;
- Contamination of drinking water;
- Fires from ruptured tanks or gas lines;
- Disruption of transportation, power, and other services;
- Loss of vital community infrastructure;
- Complete devastation of coastal areas; and
- Death.

Most deaths caused by tsunamis result from drowning.

### Tsunami Facts

The first wave of a tsunami may not be the largest in a series of waves or the most significant. A tsunami may affect coasts differently: a small tsunami in one place may be very large a few miles away depending on factors including the underwater land formation and the angle of the waves approaching the shore. A tsunami inundation zone is an area on land that can become quickly flooded when there is a tsunami.

### Tsunami Preparedness

The following outlines what you should do to prepare for a tsunami.

- Know the risk for tsunamis in the area. Areas with a risk of tsunami generally have established inundation zones and evacuation routes. Find out the local inundation and evacuation zones and evacuation plans for your home, work, and

any places you frequent regularly. Know the height of your street above sea level and the distance of your street from the coast or other high-risk waters. Authorities may issue evacuation orders based on these numbers.

- Take the time to learn the natural signs of a potential tsunami, some of which include earthquakes, a sucking/vacuum sound coming from the ocean, and receding water. However, signs vary by type of tsunami. The waterline may withdraw and disappear out to sea, followed by a series of high waves reaching farther and farther inland. Remember that the series of tsunami waves will not necessarily occur at regular intervals.
- Currently, there is no way to predict when a tsunami-causing underwater event will occur with any reliability. When such an event does occur, the first wave in a series could reach the shoreline in a few minutes, even before authorities are able to issue a warning.
- If you live or work in an area designated as vulnerable to tsunami inundation, know the evacuation plans and be ready to get to high ground and evacuate if directed. If you are visiting an area at risk from tsunamis, check with the hotel, motel, or campground operators for evacuation information.
- Develop your tsunami plan based on the local plans. If possible, pick an area 100 feet or more above sea level, or go at least 1 mile inland, away from the coastline. Be able to follow your escape route at night and during inclement weather.
- Discuss tsunamis with your family. Discussing tsunamis ahead of time will help reduce fear and anxiety and let everyone know how to respond. Review flood safety and preparedness measures with your family.
- Talk to your insurance agent. Homeowners' policies do not cover flooding from a tsunami. Ask your agent about the National Flood Insurance Program (NFIP).
- Learn about and subscribe to local tsunami alerts and warnings. Use a NOAA Weather Radio with a tone-alert feature to keep you informed of local watches and warnings.

### ***Protecting Property***

In order to protect your property from a Tsunami, take the following points into consideration:

- Avoid building or living in buildings within several hundred feet of the coastline. These areas are most likely to experience damage from tsunamis, strong winds, or coastal storms.
- Elevate coastal homes. Most tsunami waves are less than 10 feet high.
- Consult with a professional for advice about ways to make your home more resistant to tsunami. In addition, there may be ways to divert waves away from your property.

## Alerts and Warnings

NOAA's two tsunami-warning centers monitor Earth for earthquakes and tsunamis, forecast tsunami impacts and issue tsunami alerts for the United States to emergency managers and the public:

- The National Tsunami Warning Center West Coast/Alaska Tsunami Warning Center (WC/ATWC) serves the continental United States, Alaska, and Canada.
- The Pacific Tsunami Warning Center (PTWC) is responsible for providing warnings to international authorities, the Hawaiian Islands, the U.S. Pacific and Caribbean territories, the British Virgin Islands, and is the primary international forecast center for the Intergovernmental Oceanographic Commission of the United Nations.

Authorities may update or cancel tsunami warnings, advisories, and watches as information becomes available. They also may update advisories, watches, and information statements if they determine that the threat is greater than they originally thought. Local radio and television, marine radio, wireless emergency alerts, NOAA Weather Radio, and NOAA websites, such as [www.tsunami.gov](http://www.tsunami.gov), broadcast tsunami warnings. They may also come through outdoor sirens, local officials, text message alerts, and telephone notifications.

### *Tsunami Watch*

When NOAA issues this alert, it means: A distant earthquake has occurred. A tsunami is possible. Stay tuned for more information. Be prepared to take action if necessary.

### *Tsunami Advisory*

When NOAA issues this alert, it means: A tsunami with potential for strong currents or waves dangerous to those in or very near the water is expected or occurring. There may be flooding of beach and harbor areas. Stay out of the water and away from beaches and waterways. Follow instructions from local officials.

### *Tsunami Warning*

When NOAA issues this alert, it means: A tsunami that may cause widespread flooding is expected or occurring. Dangerous coastal flooding and powerful currents are possible and may continue for several hours or days after initial arrival. Follow instructions from local officials. Evacuation is recommended. Move to high ground or inland.

## During a Tsunami

The following outlines what you should do if authorities issue a tsunami warning.

- If you are in a tsunami risk area and you hear an official tsunami warning or detect signs of a tsunami, evacuate at once. Authorities issue a tsunami warning when they are certain that a tsunami threat exists, and there may be little time to get out.
- Follow instructions issued by local authorities. Recommended evacuation routes may be different from the one you planned, or authorities may advise you to move to higher ground than you had planned.

- Get to higher ground as far inland as possible.
- If unable to get to higher ground or move inland in a timely fashion, move to the upper levels of a tall, fortified building to minimize your hazard exposure. Some vertical evacuation structures specifically designed to resist tsunamis are marked with a sign of a cresting wave.
- Listen to a NOAA Weather Radio or Coast Guard emergency frequency station for updated emergency information.
- If you are out on a boat when authorities issue the warning, move as far out from the coast as possible. This action could prevent the waves from carrying your craft inland where it is likely to sustain damage and the risk of death is high.
- If your boat is in the harbor, only take your boat offshore if the local authority (harbor master or port captain) permits it and you have supplies to remain at sea for two or three days.

### ***Tsunamis and Earthquakes***

Earthquakes can initiate tsunamis. If a strong, coastal earthquake occurs:

- Drop, cover, and hold on. You should protect yourself from the earthquake first.
- When the shaking stops, move quickly inland and to higher ground immediately and listen for an official evacuation notice. If such a notice is given, leave immediately following the evacuation route.
- Leave everything else behind. A tsunami could occur within minutes.
- Avoid downed power lines and stay away from buildings and bridges from which heavy objects might fall during an aftershock.

### **After a Tsunami**

Following a tsunami, citizens should continue listening to a NOAA Weather Radio or Coast Guard emergency frequency station for updated emergency information and instructions. The following outlines your post-tsunami actions:

- Return home only after local officials tell you it is safe. A tsunami is a series of waves that may continue for hours. Do not assume that after one wave, the danger is over. The next wave may be larger than the previous one.
- Do not attempt to drive through areas that are still flooded.
- Avoid wading in potentially contaminated floodwater, which can hide dangerous debris.
- Avoid fallen power lines or broken utility lines and immediately report those that you see.
- Stay out of damaged areas until told it is safe to enter.
- Be aware of areas where flooding may have occurred. Impacts from the tsunami may damage roads and bridges, potentially causing them to collapse under the weight of a vehicle.

- Stay out of damaged buildings. If your home was severely flooded, you may only be able to enter when officials say it is safe to do so.
- Throw out any food, even canned food exposed to flood waters, as it may be contaminated.

**Table 9** below reviews some common myths about tsunamis and explains why each is not true.

**Table 9: Tsunami Myths and Facts**

Myth	Fact
<b>Tsunamis are giant walls of water.</b>	Tsunamis normally have the appearance of a fast-rising and receding flood. They can be similar to a tide cycle occurring every 5 to 60 minutes rather than every 12 hours. Occasionally, tsunamis can form walls of water, known as tsunami bores, when the waves are high enough and the shoreline configuration is appropriate.
<b>Tsunamis are a single wave.</b>	Tsunamis are a series of waves. The initial wave is not always the largest wave in the series. In fact, the largest wave may occur several hours after the initial activity has started at a coastal location.
<b>Boats should seek protection of a bay or harbor during a tsunami.</b>	Tsunamis are often most destructive in bays and harbors. Tsunamis are least destructive in deep, open ocean waters. Boats already out to sea should travel as far out as possible to prevent them from being carried to shore.

[This page intentionally left blank]



# CERT Hazard Annex: Volcano

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

A volcano is a vent in the Earth where magma and gases erupt. Unlike other mountains, which are pushed up from below, volcanoes are built by surface accumulation of their eruptive products—layers of ash, ash flows, and lava. When pressure from gases within the molten rock becomes too great, an eruption occurs.

The United States ranks third in the world, after Japan and Indonesia, for the number of active volcanoes. The United States and its territories contain 169 geologically active volcanoes, of which 54 are a very high or high threat to public safety. States and territories with active volcanoes according to the U.S. Geological Survey (USGS) include: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, and the Northern Mariana Islands.

Alaska, California, Hawaii, Oregon, and Washington are the most volcanically active states in the United States. The Kilauea volcano in Hawaii has been erupting regularly since 1983. Alaska, where eruptions occur almost annually, has the most active volcanoes in the United States.

### Types of Volcanoes

- **Snow-clad volcanoes** (e.g., those found in Alaska and the Pacific Northwest) bring substantial hazards from lahars, which are a mixture of water and rock fragments that flow down the slopes of a volcano. Lahars can inundate valleys more than 50 miles downstream.
- **Explosive volcanoes** (e.g., those found in Alaska and parts of the American west) bring risk of volcanic ash that can affect areas close by and hundreds to thousands of miles from the volcanic vent.
- **Weakly explosive volcanoes** (e.g., those found in Hawaii) typically erupt gently with fluid lava flows and increased risk of vog—a combination of fog, smoke, and volcanic gas.

### Volcano Impacts

Between 1900 and 2008, volcanoes have caused more than 100,000 deaths worldwide, an average of 430 deaths per eruption. Pyroclastic flows, fast-moving clouds of hot ash, gas, and volcanic material, are responsible for the majority of deaths, but fatalities are also produced by ash asphyxiation and trauma.

### Volcano Facts

Volcanoes produce a wide variety of hazards that can kill people and destroy property. Volcanic hazards include:

- Eruptions;
- Lava;
- Pyroclastic flows;
- Lahar;
- Volcanic gases;

- Tephra/Ash;
- Landslides; and
- “Vog” (a combination of fog, smog, and volcanic gas).

Some types of hazards (i.e., lava, pyroclastic density currents, tephra, gases, and lahars) affect people on the slopes of a volcano. Other hazards (i.e., lahars) affect people on valley floors tens of miles away from the actual eruption. Still other volcano-related hazards (i.e., volcanic ash, vog) impact people in the air and on the ground downwind.

### **Eruptions**

Eruptions can be relatively quiet, producing lava flows that creep across the land. Explosive eruptions can shoot columns of gases and rock fragments tens of miles into the atmosphere, spreading ash hundreds of miles downwind.

### **Lava**

Lava flows are streams of molten rock that either pour from a vent quietly or erupt explosively as lava fountains. Because of their intense heat, lava flows are also great fire hazards. Lava flows destroy everything in their path, but most move slowly enough that people can move out of the way.

It is nearly impossible to channel the lava flow away from towns and neighborhoods. Individual should never attempt to divert a lava flow. Ultimately, it will destroy anything in its path. Lava flows can travel as fast as 40 mph. The speed at which lava moves across the ground depends on several factors, including the:

- Type of lava that has erupted;
- Steepness of the ground; and
- Rate of lava production at the vent.

The distance traveled by a lava flow depends on such variables as:

- The viscosity of the lava;
- Volume erupted;
- Steepness of the ground; and
- Obstructions in the path of the flow.

### **Pyroclastic Flow**

Pyroclastic flows contain a high-density mix of hot lava blocks, pumice, ash and volcanic gas. They move at very high speed down volcanic slopes, typically following valleys and traveling at speeds typically greater than 50 mph. Pyroclastic flows destroy nearly all objects and structures in their path. The extreme temperatures of rocks and gas inside pyroclastic flows, generally between 390 – 1300 degrees Fahrenheit, can ignite fires and melt snow and ice.

## Lahar

Historically, lahars have been one of the deadliest volcano hazards. Lahars are mudflows or debris flows composed mostly of volcanic materials on the flanks, or sides, of a volcano. These flows of mud, rock, and water can rush down valley and stream channels at speeds of 20 to 40 mph and can travel for more than 50 miles.

Lahars can occur during an eruption, but they can also occur when a volcano is quiet. The water that creates lahars can come from melting snow and ice, intense rainfall, or the breakout of a summit crater lake.

## Volcanic Gases

A volcano can release gases during an eruption, but they can also be released at any time from cracks in the ground that allow gases to reach the surface through fumaroles, or small openings.

More than 90 percent of all gas emitted by volcanoes is water vapor. Other common volcanic gases are carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen, and fluorine. Carbon dioxide is heavier than air and can be trapped in low areas in concentrations that are deadly to people and animals. Sulfur dioxide gas can react with water droplets in the atmosphere to create acid rain, which causes corrosion and harms vegetation. Volcanic ash particles can absorb fluorine, which in high concentrations is toxic, and can poison livestock and contaminate domestic water supplies.

## Volcanic Ash/Tephra

Volcanic ash is defined as finer pieces of tephra smaller than 1/12 of an inch. Tephra is the eruption into the atmosphere of fragments of magma. Volcanic ash is fine, glassy rock fragments that can affect people and equipment hundreds of miles away from the cone of the volcano, while tephra falls back to the ground on or near the volcano.

Volcanic ash can:

- Cause severe respiratory problems;
- Diminish visibility;
- Contaminate water supplies;
- Cause electrical storms;
- Disrupt the operation of all machinery and cause engine failure, which is particularly problematic for aircraft; and
- Collapse roofs.

## Landslides

Volcano landslides range in size from small movements of loose debris on the surface of a volcano to massive collapses of the entire summit or sides of a volcano. Steep volcanoes are susceptible to landslides because they are formed, in part, from layers of loose volcanic rock fragments. Eruptions, heavy rainfall, or large earthquakes can cause landslides.

### *Volcanic Smog (Vog)*

A form of air pollution which is created when sulfur dioxide and other volcanic gases combine and interact chemically in the atmosphere with oxygen, moisture, dust, and sunlight over periods of minutes to days. Sulfur dioxide is a poisonous gas that irritates skin and the tissues and mucous membranes of the eyes, nose, and throat. During even moderate physical activity, sulfur dioxide penetrates into the airway and can produce respiratory distress in some individuals.

### *Accompanying Hazards*

Volcanic eruptions can be accompanied by other natural hazards, including:

- Flash floods;
- Wildland fires;
- Tsunamis (under special conditions); and
- Earthquakes.

### **Volcanic Eruption Preparedness**

Key steps in volcanic eruption preparedness:

- Understand the risk. Take time to learn about the risk from volcanic eruption in your area.
- Talk to your insurance agent. Find out what your homeowner's policy will or will not cover in the event of a volcanic eruption.
- Prepare a disaster supply kit, including goggles and an N-95 respirator mask for every family member.
- Develop a communication plan. Your family may not be together when a volcano erupts, so it is important to know how you will contact one another and how you will get back together.
- Develop an evacuation plan. Everyone in your family should know where to go if they need to leave.
- Develop a shelter-in-place plan if you determine the primary risk relates to ash rather than lava flows, lahars, and other immediate, life threatening hazards.

Learn about your community's volcanic eruption warning systems and emergency evacuation plans. Different communities have different ways of providing warnings and different responses. Many communities have sirens and other warning technologies, such as online activation colors (green, yellow, orange, red), to warn the public of a possible eruption.

The USGS Volcano Hazards Program has adopted an alert-notification system nationwide for characterizing the level of unrest and eruptive activity at volcanoes.

- **NORMAL:** Volcano is in typical background, non-eruptive state. Alternatively, after a change from a higher level, volcanic activity has ceased, and volcano has returned to noneruptive background state.

- **ADVISORY:** Volcano is exhibiting signs of elevated unrest above known background level. Alternatively, after a change from a higher level, volcanic activity has decreased significantly but continues to be monitored closely for a possible renewed increase in activity or unrest.
- **WATCH:** Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain, OR eruption is underway but poses limited hazards.
- **WARNING:** Hazardous eruption is imminent, underway, or suspected.

The Volcano Notification Service (VNS) is a free service that sends you notification emails about volcanic activity happening at U.S. monitored volcanoes. You can sign up for alerts at: <https://volcanoes.usgs.gov/vns2/>.

For a map of U.S. volcanoes and current activity alerts, go to <https://volcanoes.usgs.gov/index.html>.

## During a Volcanic Eruption

- Monitor alert notification systems. The USGS VNS can provide accurate and up-to-date information about eruption status.
- Follow evacuation orders. Staying at home to wait out an eruption, if you are in a hazardous zone, could be very dangerous. Take the advice of local authorities.
- Avoid areas downwind and river valleys downstream of the volcano. Wind and gravity will carry debris and ash.
- Shelter in a building, if appropriate. If volcanic ash is the only hazard affecting you, and if you are self-supportive in your home, then authorities may advise you to seek temporary shelter. Cover and seal intakes of ventilation systems around the building. Prevent ash from entering the building through windows and doorways; seal doors and windows; and control access into the building. You may not be able to shelter indoors for more than a few hours because the weight of the ash could collapse the roof of your building and block air intakes into the building. Listen to authorities for advice on leaving the area when ashfall lasts more than a few hours.
- If outside, protect yourself from ashfall. Volcanic ash will cause severe injury to breathing passages, eyes, and open wounds, and irritation to skin. In addition, ashfall will often make travel impossible as it limits visibility and can cause engine failure.
- Be prepared for accompanying hazards. Know how to respond to reduce your risk.
- Driving while volcanic ash is in the air is hazardous. Avoid driving in heavy ashfall. If you must drive, do so slowly so that you do not resuspend ash and thus reduce visibility further. Ash can cover road markings, and it forms a slippery surface when wet. If you must stop, pull off to the side of the road. Turn off your vehicle's ventilation system.

## After a Volcanic Eruption

- The lava flow on the surface cools faster than the lava trapped inside the crust. NEVER climb on a lava crust until the proper authorities deem it safe to do so.
- Stay away from volcanic ashfall areas. The fine, glassy particles of volcanic ash will increase the health risk to children and people with existing respiratory conditions such as asthma, chronic bronchitis, or emphysema.
- If you have a respiratory ailment, avoid contact with any amount of ash. Stay indoors until local health officials advise that it is safe to go outside.
- Avoid driving in heavy ashfall. Driving will stir up volcanic ash that can clog engines and stall vehicles. Abrasion can damage moving parts, including bearings, brakes, and transmissions.
- Do not get on your roof to remove ash unless it threatens collapse, and even then, exercise great caution.

[This page intentionally left blank]

[This page intentionally left blank]



# CERT Hazard Annex: Winter Storm

Participant Manual



FEMA



[This page intentionally left blank]

## INTRODUCTION

A winter storm occurs when there is significant precipitation and the temperature is low enough that rain turns to ice, or precipitation forms as sleet or snow. A winter storm can range from freezing rain and ice, to moderate snowfall over a few hours, to a blizzard that lasts for several days, or be a combination of several winter weather conditions. Dangerously low temperatures may also accompany many winter storms.

Winter storms and colder than normal temperatures can happen in every region of the country. Winter storms can occur from early autumn to late spring depending on location.

Extreme winter weather can immobilize an entire region. Ice and heavy snowfall can knock out heat, power, and communications services, sometimes for several days. Driving and walking can become extremely hazardous due to icy conditions, snowfall accumulation, low visibility, or extreme cold. People may need to stay at home or work without utilities or other services, until it is safe to drive. Pipes and water mains can break.

Winter storms are considered “deceptive killers” because most deaths are indirectly related to the storm.

## Winter Storm Impacts

Risks to human life caused by winter storms:

- **Automobile or other transportation crashes.** This is the leading cause of death during winter storms. The Federal Highway Administration (FHWA) tracks how weather events negatively impact roads. According to the FHWA, authorities attributed 17 percent (210,341) of all weather-related crashes on an average annual basis, between 2005 and 2014 to snow or sleet; they attributed 13 percent (151,944) to icy pavement; and they attributed 14 percent (174,446) to snowy or slushy pavement.
- **Heart attacks.** Caused by overexertion, typically from clearing and shoveling heavy snow. Studies show that factors that increase the risk of heart attack (e.g., blood pressure) may rise during the colder months. One study found that among the elderly, the risk of heart attack and other cardiovascular disease can increase by as much as 6.9 percent during the winter.
- **Hypothermia and frostbite.** Death rates are highest among males and adults aged 65 and older. Hypothermia can occur anywhere outside. Between 1999 and 2015, nearly one-quarter of affected persons were at home when they became hypothermic.
- **House fires.** These occur more frequently in the winter in part because of the lack of proper safety precautions when using alternate heating sources (e.g., unattended fires, improper disposal of ashes, improper usage of space heaters). Fires during winter storms present a great danger due to the release of carbon monoxide (CO).
- **Carbon monoxide poisoning.** CO is an invisible, odorless, colorless gas created when fuels (such as gasoline, wood, coal, natural gas, propane, oil, and

methane) burn incompletely. In the home, heating and cooking equipment that burn fuel are potential sources of carbon monoxide. Vehicles or generators running in an attached garage can also produce dangerous levels of carbon monoxide.

## Winter Storm Facts

The elements of winter storms include:

- Significant precipitation, including heavy snowfall;
- Temperature is low enough that precipitation forms as sleet or snow, or when rain turns to ice;
- Winter flooding; and
- Extreme cold.

### *Significant Precipitation*

Significant precipitation, including heavy snow can:

- Knock out heat, power, and communication services;
- Immobilize regions and paralyze cities;
- Strand commuters;
- Close airports; and
- Disrupt emergency and medical services.

Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Pipes and water lines can freeze and break. Homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of removing snow and repairing damage, and the resulting loss of business, can have severe economic impacts on cities and towns.

Avalanches are flowing masses of snow that move rapidly downhill and are a threat in the mountains. An avalanche may reach a mass of a million tons and travel at speeds of up to 200 mph. More than 80 percent of midwinter avalanches are triggered by a rapid accumulation of snow, and 90 percent of those occur within 24 hours of snowfall. According to the Colorado Avalanche Information Center, over the past 10 years, 27 people died in avalanches in the United States each year.

There are several different kinds of snowfall:

- **Blizzards** are accompanied by winds of 35 mph or more with snow and blowing snow, reducing visibility to less than one-quarter mile for at least three hours.
- **Blowing snow** is wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- **Snow squalls** are brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.

- **Snow showers** are a short duration of moderate snowfall. Some accumulation is possible.
- **Snow flurries** are light snow falling for short durations with little or no accumulation.

### Ice

Heavy accumulations of ice can disrupt communications and power for days while utility companies repair extensive damage. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces.

There are three different kinds of ice:

- **Sleet** is frozen precipitation melts and refreezes into sleet before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects. Sleet can accumulate like snow and cause a hazard to motorists.
- **Freezing rain** is frozen precipitation that melts in warm air. As the rain falls, it freezes on cold surfaces as a sheet of ice. Even small accumulations of ice can cause a significant hazard.
- **Ice storms** are events that occur when freezing rain falls and freezes immediately on impact. Communications and power can be out for days.

### Winter Flooding

Winter storms can generate coastal flooding, ice jams, and snowmelt, resulting in significant damage and loss of life.

There are three different kinds of winter flooding:

- **Coastal floods** begin with winds generated from winter storms, causing widespread tidal flooding and beach erosion along coastal areas.
- **Ice jams** begin with long cold spells can cause rivers and lakes to freeze. A rise in the water level or a thaw breaks the ice into large chunks that become jammed at manmade and natural obstructions. An ice jam can act as a dam, resulting in severe flooding.
- **Snowmelt** is a sudden thaw of a heavy snow pack that often leads to flooding.

Exposure to cold can cause frostbite or hypothermia and become life threatening. Infants and the elderly are the most susceptible.

What constitutes extreme cold varies in different parts of the country:

- In the South, near-freezing temperatures are considered extreme cold. Near-freezing temperatures may damage citrus fruit crops and other vegetation and they may freeze and burst pipes in homes with poor insulation.
- In the North, extreme cold means temperatures well below zero.

When talking about cold, you should consider:

- **Wind chill:** Wind chill is not the actual air temperature; instead, it is how wind and cold feel on exposed skin. As the wind increases, it carries heat away from the body at a faster rate, driving the body's temperature down.
- **Frostbite:** Frostbite is a bodily injury caused by freezing resulting in loss of feeling and color in affected areas. It most often affects the nose, ears, cheeks, chin, fingers, or toes. Frostbite can permanently damage the body, and severe cases can lead to amputation. At the first sign of redness or pain in any skin area, get out of the cold or protect any exposed skin—frostbite may be beginning. Symptoms of frostbite include:
  - A white or grayish-yellow skin tone;
  - Skin that feels unusually firm or waxy; and
  - Numbness in extremities.

People with frostbite require medical treatment. First, determine whether the victim also shows signs of hypothermia (defined below). If hypothermia is present, warm the body core before the extremities. If there is frostbite, but no sign of hypothermia, follow the ensuing guidance:

- Get to a warm room as soon as possible.
  - Do not walk on frostbitten feet or toes unless necessary.
  - Immerse the affected area in warm—not hot—water. (The temperature should be comfortable to the touch for unaffected parts of the body).
    - Alternatively, warm the affected area using body heat. For example, you can use the heat of an armpit to warm frostbitten fingers.
  - Do not rub the frostbitten area or massage it at all, as this can cause more damage.
  - Do not use a heating pad, heat lamp, or the heat from a stove, fireplace, or radiator to warm yourself, as doing so may burn the affected areas that are numb.
- **Hypothermia:** Hypothermia is a dangerous condition that can occur when a person is exposed to cold temperatures for a prolonged period. When exposed to cold temperatures, the body begins to lose heat faster than it is produced. Lengthy exposures will eventually use up the body's stored energy, which leads to lower body temperature.

While hypothermia is most likely at very cold temperatures, it can occur even at cool temperatures (above 40 degrees Fahrenheit) if a person becomes chilled from rain, sweat, or submersion in cold water.

Hypothermia may also be caused by trauma. People with very serious injuries are more susceptible to hypothermia and it can increase the risk of death.

The primary signs and symptoms of hypothermia are:

- Shivering;
- Exhaustion;

- Confusion;
- Fumbling hands;
- Memory loss;
- Slurred speech; and
- Drowsiness.

If you notice any of these signs, take the person's temperature. If it is below 95 degrees Fahrenheit, the situation is an emergency. Begin warming the person, as follows:

- Get survivor to a warm room or shelter.
- Remove wet clothing.
- Put something in between the patient and the ground to prevent additional heat loss.
- Warm the center of the body first—chest, neck, head, and groin—using an electric blanket, if available. You can also use skin-to-skin contact under loose, dry layers of blankets, clothing, towels, or sheets.
- Warm beverages can help increase body temperature, but do not give alcoholic beverages. Do not try to give beverages to an unconscious person.
- After body temperature increases, keep the person dry and wrapped in a warm blanket, including the head and neck.
- Keep them sheltered (i.e., out of the elements) and warm with blankets, sleeping bags, cardboard, etc.
- Do not attempt to use massage to warm affected body parts.
- Place an unconscious patient in the recovery position.

## Winter Storm Preparedness

What are the differences between a **Winter Weather Advisory**, **Winter Storm Watch**, **Winter Storm Warning**, and **Blizzard Warning**?

- Authorities issue a **Winter Weather Advisory** when conditions are expected to cause significant inconveniences that may be hazardous.
- Authorities issue a **Winter Storm Watch** when severe winter conditions, such as heavy snow and/or ice, may affect your area but the location and timing are still uncertain. Authorities issue a Winter Storm Watch 12 to 36 hours in advance of a potential severe storm.
- Authorities issue a **Winter Storm Warning** when four or more inches of snow or sleet are expected in the next 12 hours, or 6 or more inches in 24 hours, or ¼ inch or more of ice accumulation is expected. The NWS may also issue a warning if the storm is expected to hit during high-traffic times, like rush hour.

- A **Blizzard Warning** means sustained winds or frequent gusts of 35 mph or greater and considerable falling or blowing snow (reducing visibility to less than a quarter mile) are expected to last for a period of three or more hours.

What are the differences between a **Wind Chill Advisory**, **Wind Chill Watch**, and a **Wind Chill Warning**?

- **Wind Chill Advisory: Be Aware:** NWS issues a wind chill advisory when seasonably cold wind chill values, but not extremely cold values are expected or occurring. Be sure you and your loved ones' dress appropriately and cover exposed skin when venturing outdoors.
- **Wind Chill Watch: Be Prepared:** The NWS issues a Wind Chill Watch when dangerously cold wind chill values are possible. As with a warning, adjust your plans to avoid being outside during the coldest parts of the day. Make sure your car has at least a half a tank of gas and update your winter survival kit.
- **Wind Chill Warning: Take Action!** The NWS issues a Wind Chill Warning when dangerously cold wind chill values are expected. If you are in an area with a Wind Chill Warning, avoid going outside during the coldest parts of the day. If you do go outside, dress in layers, cover exposed skin, and make sure at least one other person knows your whereabouts. Update them when you arrive safely at your destination.

Key steps in winter storm preparedness:

- Understand the risk. Take time to learn about the winter storm risk in your area. Realize the seriousness of such storms; they may leave you on your own for an extended period.
- Prepare your home with insulation, caulking, and weather stripping. Learn how to keep pipes from freezing and how to thaw frozen pipes. Install and test smoke alarms and battery-operated or electric carbon monoxide detectors with battery backup in central locations on all levels of your home and outside sleeping areas.
- Ensure your home emergency kit includes warm clothing, blankets, and waterproof footwear and gloves.
- Build an emergency supply kit for your car. Include cellular phone charger, first aid kit, jumper cables, flares, whistle, snow and ice removal equipment, bags of sand or cat litter, a flashlight, ice scraper, towrope, shovel, tire chains or snow tires, warm clothes, blankets, extra gloves, warm boots, bottled water, and non-perishable snacks. Keep your car's gas tank full for emergency use. Contact a mechanic regarding how to winterize your vehicle.
- Pay attention to warnings. Use a NOAA Weather Radio with a tone-alert feature or listen to local radio or television for Emergency Alert System (EAS) broadcasts.

## During a Winter Storm

- Stay indoors and dress warmly.

- Limit your time outdoors. If you must go outside, wear layers of loose-fitting, lightweight, warm clothing. Watch for signs of hypothermia and frostbite.
- Avoid overexertion, as this may cause cardiac arrest (e.g., shoveling heavy snow). Walk carefully when on snowy, icy sidewalks.
- Close off unused rooms to consolidate and retain heat.
- Never use outdoor heating sources indoors. Do not use heat sources inside that are designed for outside use; they produce carbon monoxide and are not designed with ventilation. Maintain ventilation when using kerosene heaters to avoid build-up of toxic fumes, resulting in carbon monoxide poisoning. Refuel kerosene heaters outside and keep them at least three feet from flammable objects.
- Never use a generator inside. NEVER use a portable generator inside the home. Keep generators and other alternate power/heat sources outside, at least 20 feet away from windows and doors and protected from moisture; and NEVER try to power the house wiring by plugging a generator into a wall outlet.

DO NOT travel if advised against it or if not necessary.

You should also take measures to protect yourself if you must drive during a winter storm:

- Re-check car maintenance and make sure you have a full tank of fuel.
- Keep a cell phone or two-way radio with you when traveling in winter weather. Make sure that the batteries are charged; include a back-up cell phone charger.
- Make sure you regularly update your car emergency supply kit.
- Plan long trips carefully and notify someone of your destination, route, and expected time of arrival.
- If you get stuck, know when to stay or leave the car.
- Check the forecast when venturing outside. Even colder temperatures often follow major winter storms.

### After a Winter Storm

- Monitor local news for emergency information and updates.
- Dress in warm clothing, stay dry, and prevent prolonged exposure to cold and wind.
- Be careful walking on ice and packed snow.
- Avoid overexertion when clearing and shoveling snow.
- Only drive if necessary. Remove snow and ice from your tailpipe before starting your car and check regularly if idling. Clean all snow and ice from your car before driving

