Key Planning Factors and Considerations

For Response to and Recovery from a Chemical Incident

August 2021

FEMA

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While you Read

Throughout *Key Planning Factors and Considerations for Response to and Recovery from a Chemical Incident*, you will find a system of specialized callout boxes which denote opportunities to take action, coordinate with other governments or agencies, or reference external materials. A guide to those specialized callout boxes is provided here.

Action Item

A suggested activity to complete during planning

Coordination Opportunity

An example of interagency coordination highlighted in the content

Refer To

Guidance for locating more information from a separate resource

What Would You Do?

A critical thinking exercise or discussion question

Prologue

Key Planning Factors and Considerations for Response to and Recovery from a Chemical Incident is written for response and recovery planners at the regional, state, local, tribal, and territorial levels. A coordinated response and recovery effort will include all levels of government in addition to the private sector, non-governmental organizations, and, potentially, international partners. Planning for a chemical incident requires additional considerations beyond all-hazard preparedness planning, so this document includes strategic and operational issues for consideration when developing response and recovery plans for a chemical incident.

1. What Is A Chemical Incident?

The rise to prominence of the chemical industry over the past century and current use of innumerable chemicals in everyday life have increased the risk of exposure to or contamination by a host of substances that can threaten human, animal and/ or environmental health. Exposures may result from industrial or transportation accidents, from unintended contamination of products or from deliberate chemical releases. The recent use of chemical agents in warfare and in assassinations highlights how preparedness activities must accommodate both intentional and accidental chemical incidents. Whether a chemical incident is accidental or intentional, planning is necessary to mitigate all public and environmental health emergencies.

A chemical incident includes a wide scope of events and refers to the release, or potential release, of a chemical substance that

1. harms people, animals and/or the environment, regardless of accidental or deliberate cause,
2. for which response needs have the potential to overwhelm state and local resources (both governmental and private sector), and
3. for which the Environmental Protection Agency (EPA) and/or the United States Coast Guard (USCG), co-Chairs of the National Response Team (NRT) for Oil and Chemical Spills under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP),[1] deems that support is or will be required.

Note that response activities may be authorized in response to threatened discharges of hazardous substances that have not yet occurred.

In a chemical incident, harm to people, animals and/or the environment can result from chemical “exposures” and/or chemical “contamination.” Chemical exposure occurs when a chemical substance is absorbed into the body, while for humans (and animals), contamination means having a substance on one's clothing or body. Not all chemical exposures are caused by or result in the contamination of an individual, and contamination does not necessarily result in exposure. For humans and animals, chemical substances are potentially hazardous by ingestion, inhalation and/or dermal contact. Thus, dangerous chemical exposure or contamination can come from food, water, air, or contaminated surfaces, and the spread of chemicals in the environment (such as through air and/or water movement) increases the risk of human and animal contamination and exposure.

The actions that must be taken by first responders to initiate incident response depend upon whether a chemical release has caused environmental, human, and/or animal exposures, contamination, or both.

Figure 1: PPE-clad responders cleaning an oil spill with pom-poms and rakes

Possible chemical incidents range considerably in their scale and their potential harm to public health and the environment. Some types of events happen frequently (mishaps during the transportation of chemicals) whereas others have happened rarely (deliberate chemical attacks). Preparedness activities should consider all of these factors when formulating plans and making decisions because the complexity of responses required will also vary with scale and the nature of the substance released. For example, a large-scale terrorist attack with a persistent chemical might result in a number of injuries from exposure and require decontamination operations, while a small-scale accidental chemical release of a chemical vapor may involve exposures but not contamination and therefore may require a far less complex response. In addition, the release of pollutants or contaminants that may reasonably be anticipated to cause harmful health effects upon exposure will require more capability and deliberate planning during the response.

There are several escalating layers of systems for the federal response to chemical incidents, allowing for appropriately-scaled responses to incidents that range from the less serious to those that may have catastrophic impacts. In the case of smaller incidents, the state, local, tribal and territorial (SLTT) governments, and/or the Responsible Party (RP) are often able to effectively address the response on their own. As incidents become larger and the responses more complex, the NCP may be activated, requiring a federal On-Scene Coordinator (OSC) from the EPA or USCG. In response to the most serious incidents, for example those cases involving a Presidential Disaster Declaration under the Stafford Act, the Federal Emergency Management Agency (FEMA) provides enhanced resource coordination under the National Response Framework[2] in support of OSC authorities. (See the Federal Preparedness, Response, and Recovery section of this document for more information.) Historically, very few high-consequence chemical incidents have involved a

Stafford Act declaration – such as the 1962 Louisiana and Mississippi chlorine barge accident and the evacuation of the New York Love Canal Chemical site in 1978. More recently, a 2014 West Virginia chemical spill (described below) and the 2016 Flint, Michigan water contamination events have been declared emergencies under the Stafford Act.

Even emergencies that do not rise to the level requiring a Stafford Act declaration may tax local abilities to respond and recover. This document will provide key insights necessary to inform a successful response. To set the stage for these discussions of key response and recovery activities, several chemical incidents are discussed briefly here. Events illustrative of three categories are presented: industrial accidents, including events occurring in the chemical supply and agricultural industries; transportation accidents, including events related to the movement of large quantities of chemicals; and deliberate events, in which chemicals were employed with the intent to cause harm.

Figure 2: Flooding at a chemical plant in the wake of Hurricane Harvey

2. Industrial Accidents — Chemical Supply Industry

2.1. Flooding at a Chemical Plant

In the wake of Hurricane Harvey in late August 2017, extreme flooding at a chemical plant in Crosby, TX, led to a series of events that culminated in the spontaneous combustion and release of peroxide compounds.[3] By the time the all-clear was given in early September, in excess of 350,000 pounds of organic peroxide had burned, and more than 200 residents evacuated from within 1.5 miles of the facility had been out of their homes for a week.

As Harvey bore down on Texas, employees prepared the facility to ride out the storm. Flooding in the area was not unusual, but floods had never disabled the safety systems in place. This time, unimaginable amounts of rain would fall, and the resulting flooding would exceed equipment design elevations. In this case, multiple layers of protection failed despite highly trained workers remaining on-site to implement the facility's preparedness plans - which were, unfortunately, still inadequate.

The plant lost power, backup power, and critical refrigeration systems, with catastrophic results. Without refrigeration, some of the organic peroxide compounds on site combusted in just a few days, releasing toxic smoke into the surrounding area. Hampered by the damage and closures wrought by the hurricane, plant personnel and local emergency responders had few options to ensure a speedy and safe conclusion to the incident. They elected to plan and perform a controlled burn of the remainder of the facility's compounds.

Figure 3: Smoldering remains of the first refrigerated trailer to combust

Emergency response officials had initially decided to keep the local highway open because it served as an important route for hurricane recovery efforts in the area even though it ran through the evacuation zone around the facility. Eventually, five police officers in four vehicles driving down the highway toward the facility reported being exposed to a smoke cloud coming from the facility; they quickly experienced nausea, headaches, sore throats, and itchy watering eyes, and requested medical assistance. Following this event, all travel on the highway was stopped. In all, 21 people sought medical attention from exposure to toxic fumes generated by the decomposing peroxides.

Figure 4: Smoke rising from the chemical plant fire

The plans, efforts, and experience of facility employees were not enough to stave off a flooding disaster, particularly one beyond the imagination of the plant's safeguard planners.

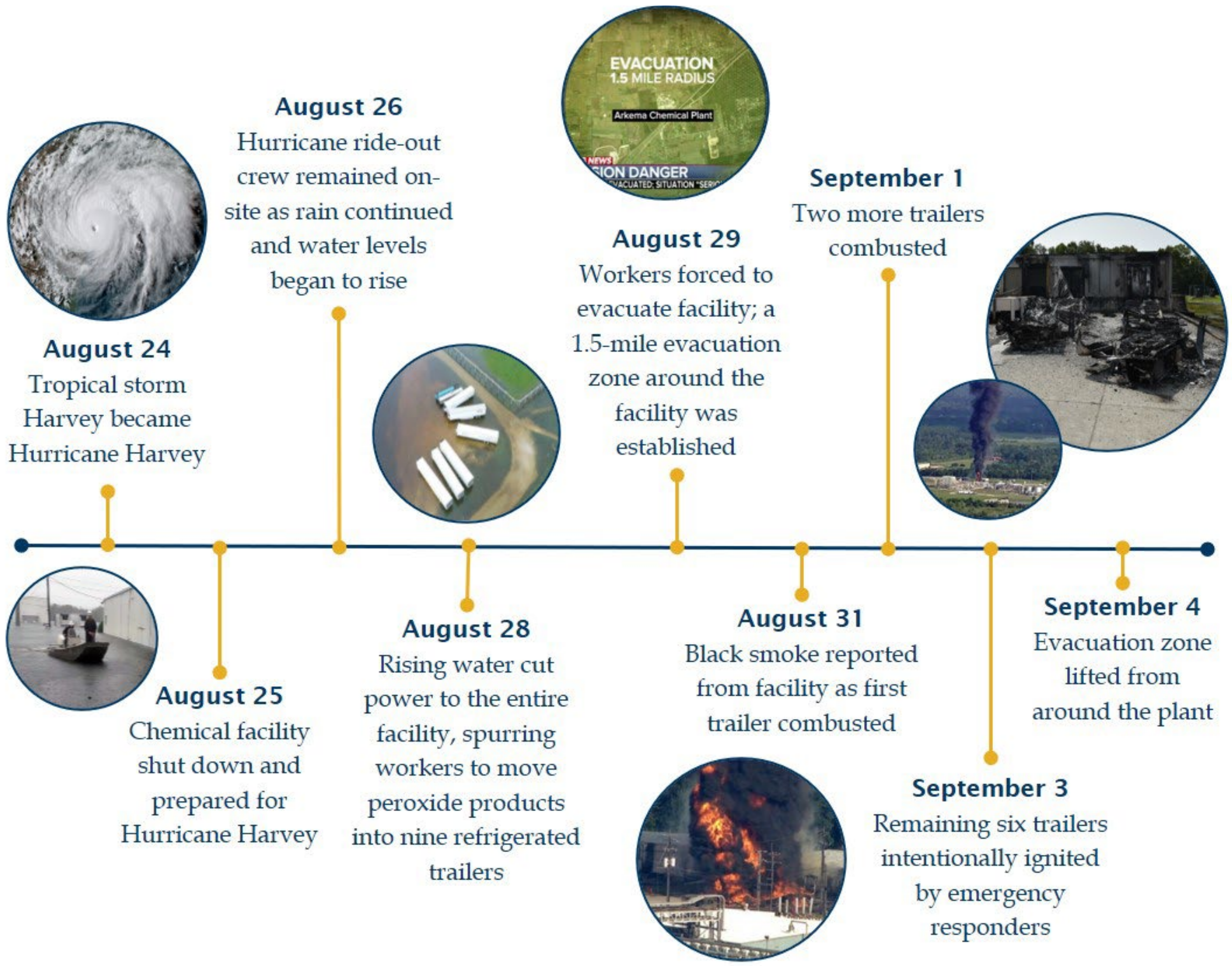


Figure 5: Timeline of incident due to chemical plant flooding and subsequent fires

Figure 6: Chemical storage tanks alongside the Elk River near Charleston, West Virginia

2.2. Chemical Leak into Waterway

On January 9, 2014, 11,000 gallons of crude methylcyclohexanemethanol (MCHM) leaked from a corroded tank at a chemical storage and distribution site in Charleston, WV, into the nearby Elk River.[4] The substance flowed downstream, quickly traveling the 1.5 miles to the intake for the West Virginia American Water (WVAW) water treatment facility. A week later (January 17), MCHM was detected as far as 400 miles downriver, in Louisville, Kentucky.[5]

The incident was recognized because of the resulting odor, first by the public (in the morning) and then by WVAW (in the afternoon). Based on initial, mistaken information regarding the identify and quantity of the leaked substance, WVAW assumed its system was capable of fully treating and removing the chemical from the water. Later that afternoon, WVAW realized that in fact, it could not, and the drinking water within WVAW's distribution system was contaminated.

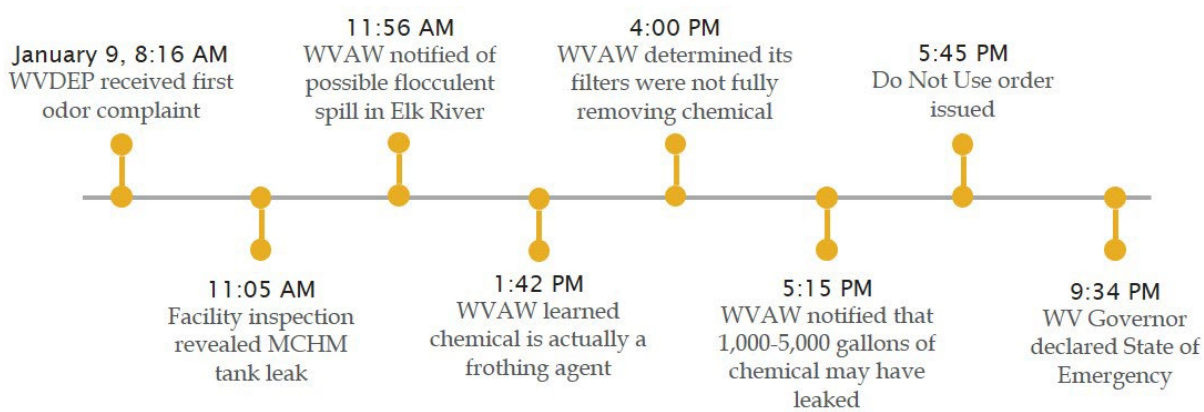


Figure 7: Timeline of incident due to chemical storage tank leak into the Elk River (Part 1)

Figure 8: Map of leak location on the Elk River

A Do Not Use (DNU) order was issued for ~300,000 residents across portions of nine counties, restricting usage of tap water for drinking, cooking and bathing for four to nine days. The DNU order resulted in closures of many businesses, schools and public offices. During this time, FEMA, the West Virginia National Guard, first responders, city governmental agencies, civic groups and multiple state agencies worked together to ensure affected residents had water available: more than 2 million one-gallon jugs and nearly 30 million bottles of water were distributed to the public. The geographic and economic extent of the effects and the need for coordinated response led to the declaration of an emergency via the Stafford Act on January 10.

Response to the incident was further plagued by misinformation. In fact, it was after the DNU was lifted – 12 days after the leak – that the site operators announced that a mixture of polyglycol ethers (PPH) had been released along with the MCHM, because they were stored within the same tank. Neither emergency responders nor WVAW had been provided with safety data sheets (SDS) for PPH, a substance known to cause adverse health effects, during the incident.

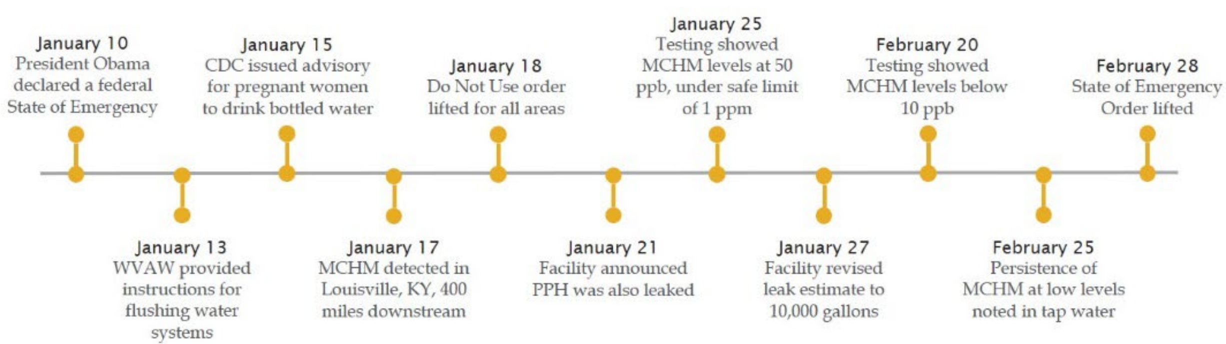


Figure 9: Timeline of incident due to chemical storage tank leak into the Elk River (Part 2)

Over the 2 weeks following the spill, area public health officials noted a surge of several hundred patients experiencing nausea, rashes, vomiting, abdominal pain and diarrhea following exposure to the water through inhalation, ingestion and/or skin contact. These patients were treated and released.

Residents in the Charleston area were given unclear and conflicting advice due to available information changing over the course of the incident. Some residents noticed an unpleasant odor in the water for several weeks following the leak, even after flushing piping as directed. As a result, many residents did not believe the water was safe to drink after water restrictions were lifted.

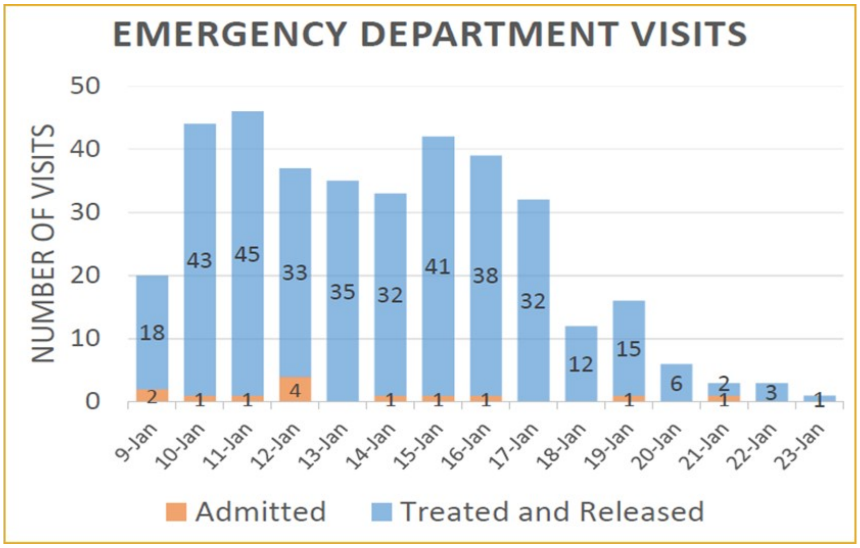


Figure 10: Summary of emergency department visits for 369 individuals treated January 9-23, 2014[4]

Figure 11: California vineyards used pesticides heavily in the 1970s

3. Industrial Accidents — Agricultural Industry

3.1. Pesticide Exposure in Farm Workers

During the 1970s, California grape growers relied heavily on organophosphorus pesticides which were known to be toxic to humans. At the time, fieldworkers were protected from harmful exposure by restricting their access to treated fields for days (or weeks) after pesticide application. Growers who used organophosphorus compounds were required to have an emergency medical plan, including arrangements for proper medical care of workers accidentally exposed to harmful levels of pesticides.[6]

On the evening of September 9, 1976, a private physician in Madera County, CA, alerted the local health official to a potential chemical poisoning.[6,7] The physician had already treated 25 field hands from a single vineyard, and now had another large group of workers, brought in by the same labor contractor, who were all suffering from nausea, vomiting, dizziness, and weakness. The health official's call to the local community hospital emergency room confirmed that a number of fieldworkers had been treated there for similar symptoms over the past day or two as well. The health official made arrangements with the county agricultural commissioner to begin a joint investigation at the vineyard the next morning.

California Department of Food and Agriculture (CADFA) laboratory analyses of vine foliage samples from vineyard locations where the workers had been harvesting when they became ill identified high levels of dialifor (Torak®) and phosalone (Zolone®), both organophosphorus pesticides in the same class of chemical as the nerve agent sarin. Workers had apparently been allowed into recently-treated areas before the expiration of the required 30-day safety interval for dialifor, and had suffered exposures to pesticide residues through the skin. In all, 118 workers from a 120-person grape-picking crew at the vineyard became ill. Of these, 85 received medical attention and three were hospitalized.

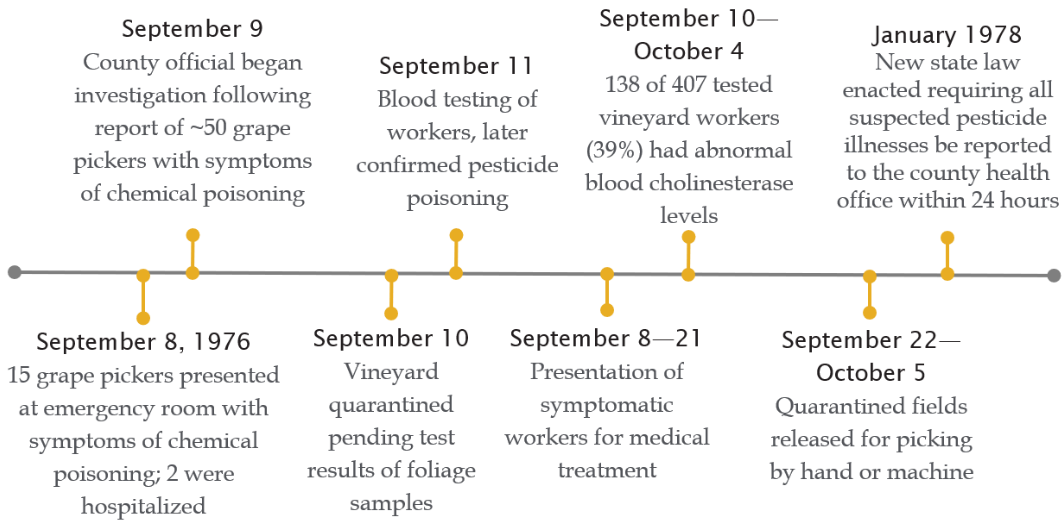


Figure 12: Timeline of incident due to vineyard worker exposure to organophosphorus pesticides

The incident may not have been noticed and worker exposures likely would have continued without the cooperation of several state and local agriculture and health agencies including CADFA, the Environmental Protection Agency, the California Department of Health, and the California Division of Industrial Safety (CAL-OSHA), and the Madera County Agricultural Commissioner's Office. Even so, this event represents the largest known single incident of such poisoning among fieldworkers in the US. The large number of acutely ill patients severely taxed medical resources; as a result, comprehensive reporting of emergency treatment by physicians fell by the wayside.

The vineyard owner was ordered not to harvest grapes from fields containing unsafe levels of pesticide residues. He sustained significant losses while his vineyards were under quarantine and had to pay substantial medical expenses and a fine for violating state regulations concerning the proper use of pesticides.

Neither dialifor nor phosalone have been used in agriculture in the US for decades.[8]

Figure 13: Application of pesticides by field workers poses risks for chemical exposures

Figure 14: School lunch programs serve many children nationwide

3.2. Contaminated School Lunches

On November 25, 2002, several students eating the school lunch in Will County, Illinois, noted an ammonia-like odor in the chicken tenders, but ate them anyway. Within an hour, dozens were vomiting in school bathrooms and hallways. The school notified the county health department, which alerted the five local hospital emergency departments to the incoming 18 ambulances transporting 42 children and two adults. In all, 157 people (151 students and 6 teachers) became ill. Miraculously, no one was hospitalized, and many of the affected individuals reported feeling well within hours of onset.[9]

Soon after, the Illinois Department of Public Health found ammonia at levels greater than 1,000 ppm in heated chicken tenders and nearly 2,500 ppm in frozen chicken tenders from the school. Although aqueous ammonia used in food processing is "Generally Recognized as Safe" (GRAS) by the US Food and Drug Administration (FDA) and levels are not limited, ingestion of ammonia at levels higher than normally found can cause gastrointestinal illness and damage, even death at sufficiently elevated levels, due to its caustic nature. The ammonia levels measured in the chicken tenders were well above both the usual limit of 15 ppm in food[10] and the < 50 ppm ammonia odor threshold.[11] This incident illustrates the unfortunate truth that, given the right circumstances, individuals will ignore unpleasant and recognizable indicators and put themselves at risk of exposure.

An investigation revealed that the chicken had been exposed to a spill of liquid ammonia (a common refrigerant) during storage in a warehouse facility a year earlier, in November 2001. Instead of being destroyed, over 300 cases of the product were re-packaged and stored for months before being distributed to nearly 50 schools throughout Illinois. At least four other schools had noticed an ammonia smell from the chicken, and one school had served the product on October 2, 2002; luckily, no unusual illnesses were noted at these schools. After the November 2002 incident, all remaining product was destroyed.

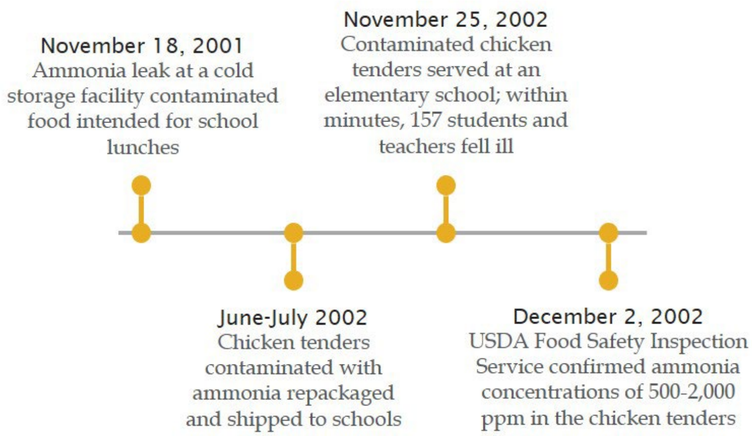


Figure 15: Timeline of incident due to ammonia contamination of chicken used in school lunches

This incident illustrates the importance of public health preparedness plans that include two-way communication between emergency and health departments. Such communications can give medical personnel valuable minutes to prepare for the arrival of large numbers of patients and review information that might allow for a more rapid diagnosis of unfamiliar conditions and preparation of an antidote, thus potentially helping save lives.

Figure 16: Railway tank cars transport a variety of hazardous chemicals in large quantities

4. Transportation Accidents

4.1. Rail Tank Car Rupture

On the morning of August 27, 2016, a rail tank car freshly loaded with nearly 180,000 pounds of liquified chlorine ruptured in New Martinsville, WV.[12] Over the next 2.5 hours, the entire load was released into the air as yellow-green chlorine vapor and migrated with the wind south along the Ohio River valley.

Figure 17: Security camera footage showing chlorine vapor cloud moving through the area

Employees immediately initiated a chlorine release alarm and the facility area was evacuated. Incident command posts were activated for Marshall and Wetzel counties, WV, and Monroe County, OH. Nearly two thousand households spread over three counties located within a 5-mile radius of the facility were ordered to evacuate. Adjacent industrial facilities activated shelter- in-place procedures. Traffic was halted on nearby state routes and rail lines, and the US Coast Guard halted commercial river traffic on the Ohio River. Because response plans were in place, officials in the area were able to rapidly implement response activities appropriate to the release event, and successfully protected area populations.

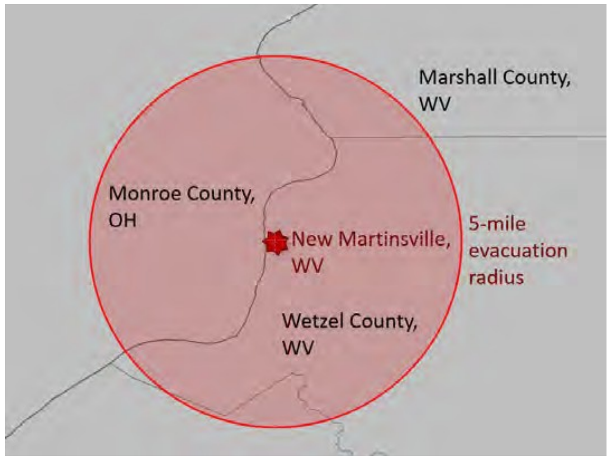


Figure 18: Map of 5-mile evacuation zone

The incident resolved quickly because liquid chlorine evaporates quickly and the resulting vapor cloud dissipated within a matter of hours. Community evacuations were lifted late that afternoon, after the WV Department of Environmental Protection (WV DEP) Homeland Security and Environmental Response Group (HSER) found no detectable chlorine at several nearby locations.

Figure 19: Fireball resulting from petroleum crude oil rail tanker derailment in Quebec

4.2. Train Derailment

During the early morning hours of July 6, 2013, the citizens of Lac-Mégantic, Quebec were awakened by fires and explosions caused by the derailment of 63 train tank cars carrying petroleum crude oil. The incident destroyed 40 buildings and claimed 47 lives. Two thousand people were evacuated.[13]

The day before, the lead locomotive of the train had been experiencing mechanical difficulties. Although smoke was coming from the lead locomotive stack, it was decided repairs could wait until the following morning. That night, the train was parked in Nantes (7.2 miles from Lac-Mégantic) on a descending grade. Overnight the train's brakes failed and at about 1:00 AM the train started to roll downhill toward Lac-Mégantic, picking up speed as it proceeded down the grade. It passed through 13 level crossings before derailing near the center of town at a speed of 65 mph. Nearly 6 million liters of petroleum crude oil were released, causing a large fire and multiple explosions.

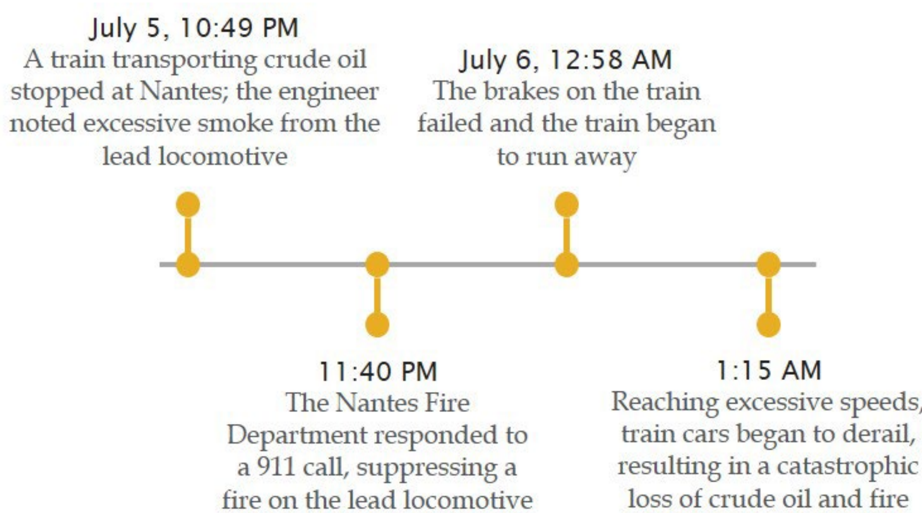


Figure 20: Timeline of incident due to derailment of train carrying petroleum crude oil in Canada

More than 1,000 firefighters from 80 different municipalities in Quebec and six counties in Maine participated in what was reported to be the largest fire response in recent Quebec history. Approximately 33,000 liters of foam – a quantity not available locally, but transported in from 180 km away – were applied to the fire to get it under control. In addition to the immediate danger from fire, the downtown area and an adjacent river and lake were contaminated with spilled crude oil and firefighting foam. Numerous organizations supported the response, including the Montreal, Maine & Atlantic Railway (MMA), Canadian National (CN) railway, the Railway Association of Canada (RAC), the federal and provincial governments, World Fuel services, Inc. (WFSI), the importer (Irving Oil Commercial GP), the petroleum industry, and environmental remediation companies.

Figure 21: Remnants of tanker cars in the aftermath of the Lac-Mégantic train derailment

Throughout the immediate accident response, regular coordination meetings were held to discuss priorities, actions and methods, and overall response progress. However, at the time of this accident, an emergency response assistance plan (ERAP), which guarantees that resources required to assist local responders during an accident will be readily available, was not required by Transport Canada's Transportation of Dangerous Good (TDG) Regulations for petroleum crude oil. In fact, at one point during the early response to this accident, work at the site stopped for several hours due to concerns about the ability of the MMA railway to cover emergency response costs. The stoppage affected the progress of both emergency response and environmental remediation efforts – in some areas, oil migrated back into zones that had earlier been declared safe.

Through the years, recovery efforts have faced considerable challenges. The oil spilled and the ensuing fires wreaked havoc on the local environment, including the contamination of multiple water sources and the town's soil to a depth of 3 m.[14] In the years following the accident, costs for rebuilding and environmental remediation have mounted; estimates have run into the hundreds of millions if not billions of dollars.[15] Even now, more than five years later, reconstruction is ongoing, and the question of who will foot the bill for the recovery efforts remains unanswered.[16]

Figure 22: Ambulance responding to an emergency in the UK

5. Deliberate Events

Deliberate chemical incidents, defined here as those in which there is intent to do harm, present special challenges to responders in terms of identifying the substance used and maintaining public calm and trust, even when the public is not immediately threatened.

5.1. Attempted Assassination

On March 4, 2018, former Soviet/Russian spy Sergei Skripal and his daughter Yulia were found unconscious on a park bench in Salisbury, UK. Although the Skripals may initially have appeared to be suffering an opioid overdose in that they were lethargic and talking incoherently when conscious, within a few days, testing by the Defence Science and Technology Laboratory (DSTL) had determined that the targets had been poisoned by a novichok nerve agent,[17] a realization that may have saved the lives of the Skripals and a responding officer.

Investigation of the incident revealed that nine sites within Salisbury required specialized nerve agent decontamination; three of these were in the city center. Clean-up work at each site involved testing, removal of potentially contaminated items, chemical cleaning and retesting. The work was overseen by the Department for Environment, Food & Rural Affairs (DEFRA) and supported by DSTL, Public Health England, the Department for Health and Social Care, the Home Office, and the Ministry of Defence (MOD). Presciently, Ian Boyd, DEFRA's Chief Scientific Adviser and chair of the decontamination assurance group overseeing the work, said "Meticulous work is required and we expect it will be a number of months before all sites are fully reopened."[18] In fact, even with the help of hundreds of specialist military personnel, it was nearly a year later and at a cost of ~£12million that all Salisbury city sites were finally declared safe.[18,19]

Then, in July of that same year, a couple was poisoned in the nearby town of Amesbury. They had found a bottle of perfume in the trash that had been laced with the novichok agent. One of the couple died as a result.[20] This second poisoning added significantly to the resources needed for clean-up efforts, and to the unrest of the public in the area.

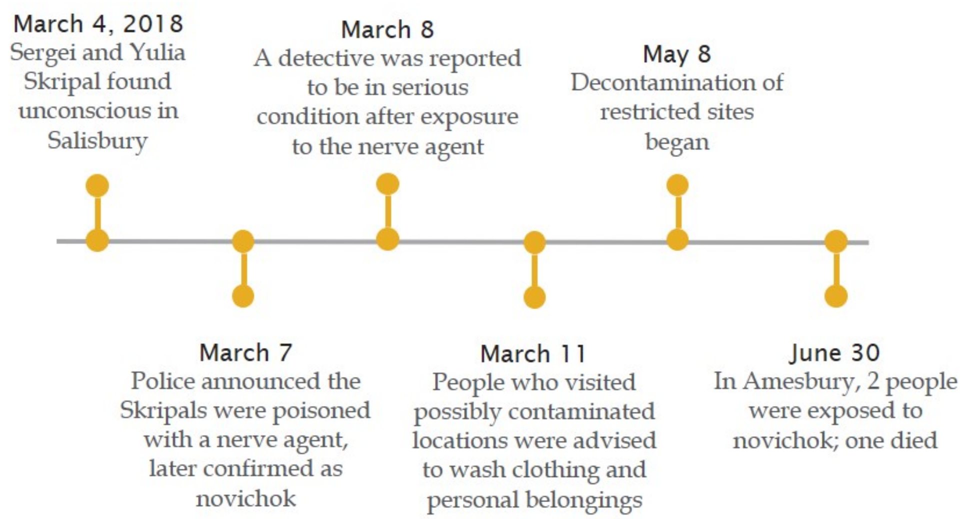


Figure 23: Timeline of incident due to attempted assassination with a chemical substance

This deliberate event illustrates the need for access to and coordination with highly specialized sampling and decontamination personnel and law enforcement/intelligence officials during the response to an event.

6. What do These Chemical Incidents Have in Common?

First, time is of the essence.
Appropriate response actions taken in the first few minutes to hours can save many lives.

The individuals in the narratives experienced health effects within minutes to hours of the chemical's release demonstrating that response actions taken in the first few minutes to hours can save many lives. Early and accurate diagnosis of symptoms can alert responders to an ongoing event. Since prevention is far better than having to respond to chemical exposures, proper planning is essential to allow responders to take advantage of this window of opportunity. Thus, community-specific response guidance must be developed prior to the event.

Communities should assess their local threats and response capabilities during the planning process. The immediacy of health effects resulting from chemical exposures implies that local and state healthcare facilities will be quickly (albeit possibly briefly) overwhelmed with requests for medical treatment. Plans and protocols that contribute to the swift and accurate diagnosis of affected individuals and identification of the causative substance will help alleviate strains on first responders and healthcare providers. The short response window also means that response activities will often be led in large part by state, local, tribal, and territorial (SLTT) officials; communities should therefore plan to support these offices.

Second, uncertainty always exists.
Useful, reliable information to guide decisions is often not available in the initial stages of a response.

Useful, reliable information to guide decisions is often not available during the initial stages of a chemical incident response, which is particularly problematic given the often time-urgent nature of key response decisions. Responders should expect that situational awareness will be rudimentary and information gathering will be ongoing during the response, but even interim data can feed into decision-making. During the planning process, planners should identify the minimum information required to make key response decisions and determine how to obtain this information quickly. Default response actions should be developed to use when event-specific information is not available. Carefully crafted communications are key to maintaining public calm, trust and cooperation.

Many response activities can proceed in the absence of detailed information about the responsible chemical substance(s). However, when responders are forced to act without full knowledge of the identity of the substance(s) involved or the extent of contamination, they, the community, and the environment are at risk of continued exposure. Again, the rapid and continuous gathering and sharing of information can help mitigate this risk.

Third, recovery is complex.
Actions taken during the response have the potential to significantly reduce the time and cost spent recovering from the event.

Actions taken during the response to a chemical incident have the potential to significantly reduce the time and cost spent recovering from the event. For example, actions taken to minimize spread of contamination can limit the area that must be decontaminated and help protect critical infrastructure. Similarly, early efforts to identify exposed individuals can facilitate long-term medical care and monitoring. Therefore, both response and recovery needs should be considered while developing regional response plans. While SLTT officials in large part lead immediate response activities for chemical release incidents, federal officials may play larger roles in later recovery and remediation activities.

7. Common Characteristics of Chemical Incidents

Harm to human health, infrastructure and the environment may occur in the immediate aftermath of a chemical incident, regardless of whether it was accidental or the result of a malicious act. The geographic area affected by an incident may be large and consequences may occur in multiple communities as contamination is moved by air or water. Cross-jurisdictional collaboration and coordination among multiple agencies at all levels is key to effectively responding to and recovering from a chemical incident.

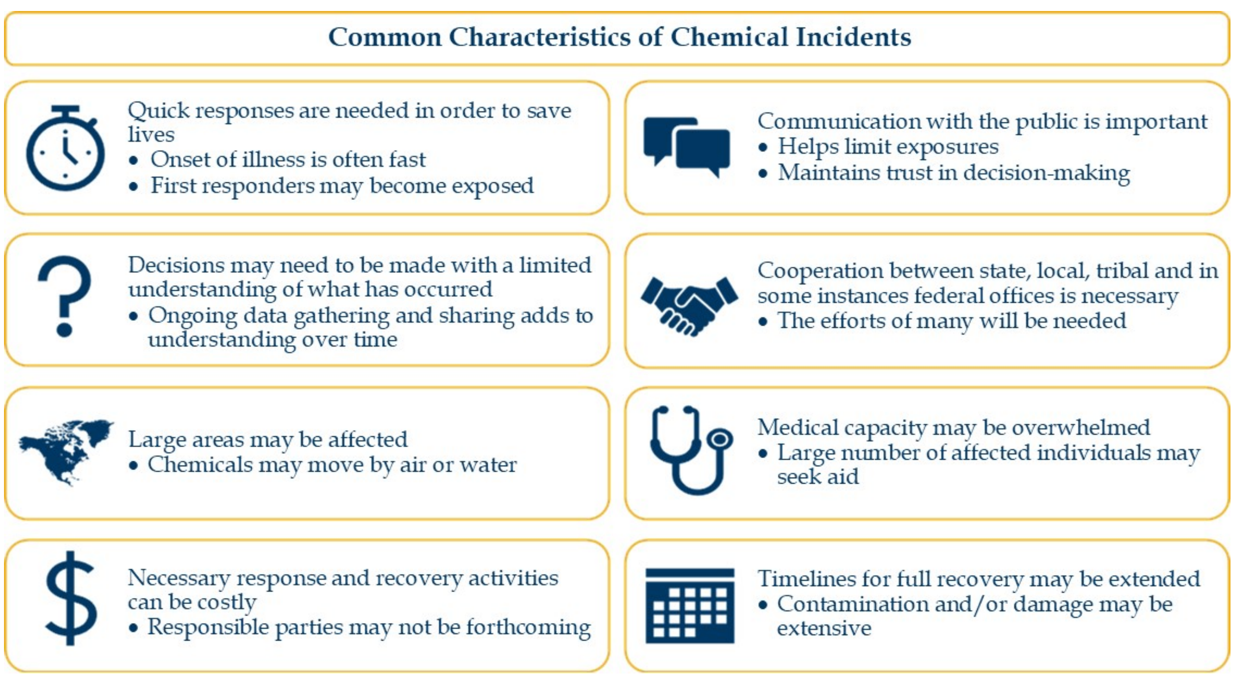


Figure 24: Common characteristics of chemical incidents

The narratives presented above were chosen to illustrate these and other important and common characteristics regarding the recognition of, response to, and recovery from different types of chemical events. For example:

Decisions must be made in the face of uncertainty. Uncertainty comes from the unexpected, such as when the chemicals stored at a flooded plant would combust, from misinformation, such as the inaccurately identified chemical leak that a local water treatment plant initially thought it could remove, and from a lack of information, such as the lack of information on the substance that was causing illness observed in farm workers or schoolchildren. In all of these cases, initial steps had to be taken to respond and reduce further risk to the public without knowing the full context of the incidents. Uncertainty will be present during planning as well; development of plans that have the flexibility to address a wide variety of scenarios is key to rapid response initiation.

First responders can become exposed. Concerns abound regarding the potential for exposure to illicit drugs during the course of their work among first responders. Following the attempted assassination in the UK, multiple first responders became contaminated with and suffered health effects from the at-the-time unknown chemical substance, because quick responses were required in the absence of information regarding the cause of the targets' illnesses. In another example, first responders fighting the crude-oil fed blaze caused by a train derailment were forced to take short shifts to avoid falling ill from the toxic fumes emanating from the site.

Interagency cooperation and integrated operations are key to response and recovery efforts. In multiple incidents described, the ability to respond quickly and/or to prevent further illness or spread of contamination required communication and coordination between multiple agencies or organizations. The example of contaminated food demonstrates how public health preparedness plans that include two-way communication between emergency and health departments can facilitate lifesaving activities. For deliberate events and accidents, support of ongoing investigation is essential, and the incident management and investigative efforts must be coordinated. Even actions as seemingly routine as shutting down roads near the site of an incident and providing adequate medical treatment to injured/ill individuals often will require the efforts of multiple responders and offices. To provide adequate capacity, resources may be needed from multiple jurisdictions and/or healthcare facilities.

Communication with the public is vital. The ability to maintain public trust and transmit new information as it is learned as a situation unfolds, with the goal of reducing risk to the public, rests upon the implementation of appropriate communication strategies. In events that require the public to take protective actions – such as the evacuations/sheltering following flooding of a chemical plant or the rupture of a single tanker car full of chlorine, or the Do Not Use instructions following the contamination a water supply – the timely provision of accessible information from trusted sources is essential for ensuring public cooperation.

Even small events can have large and possibly extended consequences. Following the chemical leak into a waterway and the attempted assassination described, the lives of the public were upended for weeks, local businesses suffered in the aftermath and contaminants were found substantial distances away from the original incident. Meanwhile, the contamination of foods at a single warehouse had the potential to sicken children across an entire state, and the contamination of agricultural workers with pesticide at a single site was enough to overtax local healthcare support capacity.

Large events can have massive and extended consequences. Loss of power and environmental (temperature) control at a flooded chemical plant and the ensuing combustion of hundreds of thousands of pounds of chemicals kept residents out of their homes for more than week. In a prime example, decontamination and reconstruction activities are still ongoing more than five years following the derailment of a train carrying crude oil; cleanup costs have skyrocketed and it is unclear who will ultimately foot the bill.

Common characteristics such as these will appear throughout the *Key Planning Factors and Considerations for Response to and Recovery from a Chemical Incident*. Keeping them in mind while reading the rest of the document will help guide the development of planning and preparedness activities appropriate for each community.

Refer To

Oil and Chemical Incident Annex (OCIA) to the Response & Recovery Federal Interagency Operational Plan (FIOP) (February 2021)

This information is supplemental to the Response & Recovery FIOP and other subordinate plans. The OCIA and accompanying documents do not alter or impede the ability of any state, local, tribal, territorial, insular area, or federal agency to execute authorities or meet responsibilities under applicable laws, executive orders, and directives.

Key Planning Factors for a Chemical Incident

Figure 25: Industrial chemical plants – potential sites of chemical incidents – are located throughout the U.S.

The Key Planning Factors (KPFs) were devised to assist in identifying the numerous considerations that should inform planning and preparedness activities for the response to and recovery from a chemical incident. They provide guidance for addressing the "core capabilities" outlined in the *Oil and Chemical Incident Annex to the Interagency Operational Plans, February 2021 (OCIA)* and fall into seven categories:

1. "Prime the Pump" Pre-Event Planning
2. Recognize and Characterize the Incident
3. Communicate with External Partners and the Public
4. Control the Spread of Contamination
5. Augment Provision of Mass Care and Human Services to Affected Population
6. Augment Provision of Health and Medical Services to Affected Population
7. Augment Essential Services to Achieve Recovery Outcomes

The challenges posed by a chemical incident and corresponding response and recovery strategies will be largely dependent on the substance released—for example, its potential to cause human injury or environmental harm, the existence or lack thereof of specialized medical countermeasures for the treatment of exposures and/or injuries, and/or its potential to persist as a long- term contaminant. Since the number of chemical substances in use with the potential to cause such challenges numbers in the thousands, likely the tens of thousands, no one document can discuss planning factors for response and recovery activities that specifically address all chemicals of concern. Instead, *Key Planning Factors and Considerations for Response to and Recovery from a Chemical Incident* takes a broad approach to planning for response to and recovery from a chemical incident, making it a helpful resource in a wide range of situations.

KPF 1 “Prime the Pump” Pre-Event Planning

Chemical incidents can quickly overwhelm a community’s emergency response system and often require specialized resources which may not be immediately available. Decisions made and communicated within the first few hours of an event can dramatically reduce the spread of contamination and the number and severity of injuries. Engaging in pre-incident preparedness activities can help ensure the community understands, plans for, and tailors the response system to the most likely chemical risks, while building an understanding of how a chemical incident response fits into the larger all-hazards response system. Effective pre-event planning can help mitigate short- and long-term incident consequences and potentially reduce time and cost of recovering from a chemical incident, leading to a more efficient and effective response and recovery.

1. Why Pre-Event Plan?

A large-scale chemical incident with mass casualties is a realistic threat facing both urban and rural communities nationwide. The risk of misuse or accidents involving toxic industrial chemicals (TIC), which are widely stored in large quantities and are routinely transported by rail, waterway, highway, and pipeline, is substantial. Moreover, violent extremists have declared their intention to attack the U.S. homeland and demonstrated their willingness to use chemical weapons against civilian populations overseas. The relative ease of acquiring, diverting, or synthesizing chemical warfare agents (CWAs) make chemical terrorism by a lone wolf or organized group a realistic threat.

Figure 26: Chemical industrial sites (left) and chemical accidents (right) pose threats

Whether the result of a deliberate malicious act, including terrorism, natural disaster, or an industrial accident, a large-scale chemical incident poses immense challenges to communities: released chemicals can spread quickly, and the response timeline to prevent fatalities is often extremely short. Decisions made and communicated within the first few minutes to hours of an event can dramatically reduce the number of casualties and the severity of their injuries. However, the information needed to make these decisions is complex and difficult to obtain and verify. Additionally, the individuals responsible for these decisions may not fully understand their need to share information and coordinate effectively with critical response stakeholders.

The short response timeline that often characterizes chemical incidents demands that preparedness begins and ends at the community level. The greatest impact on response that the federal government can make is before an incident ever happens, by supporting state- and local-level preparedness efforts. Therefore, to avoid unnecessary harm and ensure decision-making proceeds as smoothly as possible during an incident, the community must “Prime the Pump” on response and recovery activities. That is, the community must come together to prepare, plan, and prioritize; establish working groups and decision-making procedures; and develop wide- ranging communications strategies. Pre-incident planning activities have the potential to substantially influence the response and recovery process by: increasing the speed of response and the rate of recovery; reducing recovery costs; improving public health and safety; addressing major resource limitations; and/or informing critical decisions. The swift protection of populations surrounding a chlorine release described in the Prologue is a pre-incident planning success story: since the appropriate plans were already in place, local responders were able to quickly make the decisions needed to ensure safety and lead an effective response.[12]

Whether an act of chemical terrorism or an industrial accident, a large-scale chemical incident poses immense challenges to communities.

1.1. Keep in Mind: Natural Hazards Incidents are More Familiar than Chemical Incidents

While the response to and recovery from a chemical incident is similar to the response to and recovery from a natural hazard incident, several critical aspects are different. Moreover, chemical incidents may be caused by a natural disaster. In this instance, the resulting scenario could present an incredibly demanding and complex response operating environment with challenges in the distribution of emergency response resources, and/or a major chemical release that cannot be immediately addressed due to adverse conditions. Building and maintaining public confidence in governmental decisions and direction is a major consideration, and the importance of honest, accurate, timely, and frequent communication to the public cannot be overstated.

Additional challenges posed by chemical incidents must also be factored into incident recovery. Recovery activities must balance risk-based remediation processes with concerns for economic recovery and revitalization. They may also require levels of trust, transparency, and stakeholder involvement well beyond those needed in traditional disaster recovery scenarios. Comprehensive pre-incident planning provides a community with its greatest potential for achieving response and recovery goals.

Natural hazards incidents are more familiar than chemical incidents

Responders are more familiar with natural hazards than large- scale chemical incidents.

Compared to natural incidents, chemical incidents can cause minimal physical damage.

The chemical hazard may be unseen, and exposure standards may be uncertain.

In a chemical incident, contaminated areas or materials may require specialized decontamination or disposal procedures.

Recovery from chemical incidents may require greater levels of trust, transparency, and stakeholder involvement than natural disasters.

Additional resources may be required in a chemical incident, such as decontamination resources and laboratory analysis capacity.

The planning and preparedness activities discussed in this “Prime the Pump” Key Planning Factor include taking steps to:

Develop stakeholder working groups tasked with critical information gathering and plan and process development that are inclusive, transparent, and accountable.

Identify and understand the community’s unique chemical risks and gaps in its response capabilities.

Ensure effective communication of the chemical risks and response gaps so that the community plans for the most likely chemical risks, while remaining cognizant of how the chemical response system fits into the larger all-hazards response system.

Understand how time-sensitive decisions are made in chaotic, ambiguous situations to improve the efficiency and effectiveness of a chemical incident response.

Develop stakeholder working groups tasked with critical information gathering and plan and process development that are inclusive, transparent, and accountable.

Implement a "whole community" concept of operations in response planning that is coordinated with local elected leadership.

Treat the community's entire emergency response system as a system of systems to help community decision-makers understand the interdependency of community relationships, resources, and components for a successful response.

Due to the short response timeline often involved in chemical incidents, preparedness begins and ends at the community level.

2. Identify and Understand the Community's Chemical Risks and Current Capability Gaps

To generate realistic and actionable plans and frameworks, communities need to understand their specific chemical risk factors and assess their current mitigation strategies and response and recovery capabilities. Comparing capabilities to risks (the potential for a hazardous chemical to be released and the consequences of that release) can identify critical gaps that must be addressed to improve preparedness.

2.1. Identify and Create Stakeholder Working Groups

Stakeholder working groups can help ensure coordinated and comprehensive planning processes and foster the development of relationships that improve disaster response and recovery collaboration and unified decision-making. Working groups can be tasked with identifying critical needs and capability gaps, and emphasizing the importance of local chemical risk assessments in driving preparedness planning and risk mitigation activities. Also, by understanding current capabilities and the complexities of local infrastructure systems, planners can identify strengths and gaps in current preparedness and can focus on areas for additional planning, training and exercises.

Since the response to and recovery from chemical and natural hazards incidents are similar in many ways, many of the stakeholder working groups that a jurisdiction may have in place to plan for natural hazards incidents can also serve as effective platforms for chemical incident preparedness. Members of such groups may include:

- First responders, fire, and lawenforcement

- Emergency management
- Local government
- Utilities, critical infrastructure, and port officials
- Public and emergency communications, including 911
- Transportation and transit authorities
- Federal agency partners
- Local businesses, Chambers of Commerce, and large area employers
- Public health, hospitals, care facilities, and mental health providers
- School districts and academic centers
- Large public venues, arenas, and convention centers
- Community leaders and populationadvocates, including for disability groups

However, certain details of chemical release scenarios will require the attention of specific additional working groups and/or the addition of subject matter experts (SMEs) with specialized knowledge to existing working groups. For example:

- Hazardous materials (HazMat) Specialists
- Chemical industry
- Poison control
- Hazardous waste management
- Fatality management (including contaminated remains)
- Academic centers
- Federal agency partners (USCG, EPA, FEMA, National Guard, etc.)

Within these working groups, stakeholders collaborate to develop a comprehensive response and recovery framework. Such a framework should include specific plans to maximize the use of available resources to achieve remediation; manage waste; rebuild housing, infrastructure, schools, businesses and the social fabric of the impacted community; and provide mental and physical health care and social support services. Through such groups, all community perspectives should be represented throughout the disaster response and recovery planning process, and the importance of transparency and accountability in the processes should be made clear.

Refer To

FEMA's *Community Lifelines Implementation Toolkit* and the *National Response Framework's* (NRF) *Emergency Support Functions* (ESF, see Appendix F) can be useful tools in structuring and operationalizing individual stakeholder working groups.

Establishing processes and protocols for coordinating disaster response and recovery activities before an incident can greatly enhance the speed and success of such activities. Established plans can be implemented more quickly and are more likely to maximize resource utilization. Because they incorporate varying perspectives, such plans are likely to meet community needs in a more holistic manner. In addition, community leaders can increase public confidence in the response and recovery process by following plan guidelines for measuring and communicating about response and recovery progress, further promoting transparency and accountability.

The following sections outline critical information gathering and plan and process development activities in which chemical incident stakeholder working groups can play key leading roles. The greater the number and diversity of agencies and stakeholders in a region, the more important it will be to identify working group participants and stakeholder champions who appropriately reflect the composition of the community and can ensure a more representative and inclusive decision-making process. Pre-identifying participants by position and/or skill set/expertise streamlines and adds transparency to the process, and aids in gaining buy-in from the public.

Coordination Opportunity

Stakeholder working groups should be established that have knowledge of and access to area programs and their resources. Groups should become familiar with sources of funding that can support response and recovery efforts. This involves:

- Identifying stakeholders
- Socializing chemical incident scenarios and key planning needs

2.2. Chemical Risk Assessment

A locally-tailored chemical risk assessment will help focus community-wide preparedness activities toward the higher-risk scenarios and inform the community's future preparedness investments (e.g., technology and medical countermeasures). Such a risk assessment may begin with existing site-level and broader community- based all- hazards risk assessments, layered with the identification of potential chemical release sites and associated areas and populations at risk. Release sites may include chemical manufacturing plants, factories, pipelines, railways, and agricultural sites/facilities, among others. Chemicals and sites posing release risks can be recognized based on their hazardous properties inventory volumes as well as by the site's attractiveness to malicious actors of various types. Protective actions for the release site and surrounding areas can be informed with this knowledge.

Under the auspices of the Environmental Protection Agency (EPA), data are made available by law to provide chemical risk information useful for planning; many of these datasets are available freely online and can be downloaded for ingestion into a jurisdictions' systems like ArcGIS. In addition, leveraging the jurisdiction's contributions to the community Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) risk assessment processes conducted according to FEMA guidance will both enhance its risk assessment efforts and strengthen jurisdictional grant applications and justifications for investment in preparedness.

Refer To

Hazardous Materials Emergency Planning Guide (2001)

The 16 federal agencies of the National Response Team produced the NRT-1 guidance to help communities prepare for incidents involving hazardous materials. NRT-1 describes how to form a local planning team, find a team leader, identify and analyze hazards, identify existing response equipment and personnel, write a plan, and keep a plan up-to-date.

Emergency Planning and Community Right-to-Know Act (1986)

The EPCRA was created to help communities plan for chemical emergencies. It requires industry to report on the storage, use and releases of hazardous substances to federal and SLTT governments, and requires SLTT governments to use this information to prepare for and protect their communities from potential risks. EPCRA-mandated planning and preparedness infrastructure at the state and local levels includes State Emergency Response Commissions (SERCs), Tribal Emergency Response Commissions (TERCs), Local Emergency Planning Committees (LEPCs), and Tribal Emergency Planning Committees (TEPCs).

Oil Pollution Act (OPA) (a 1990 amendment of the Clean Water Act)

The OPA includes national planning and preparedness provisions for oil spills that are similar to EPCRA provisions for extremely hazardous substances. Plans are developed at the local, state, and federal levels. The OPA plans offer an opportunity for LEPCs to coordinate their plans with area plans and with local facility oil spill plans (Facility Response Plans, FRPs).

Clean Air Act Amendments (1990)

The Clean Air Act Amendments require the EPA and the Occupational Safety and Health Administration (OSHA) to issue regulations for chemical accident prevention. Facilities that have certain chemicals in quantities above specified thresholds are required to develop a risk management program to identify and evaluate hazards and manage those hazards safely; facilities subject to EPA's Chemical Accident Prevention regulations must submit a risk management plan (RMP).

Community Threat and Hazard Identification and Risk Assessment

The community THIRA is a three-step risk assessment process that helps communities understand their risks and what they need to do to address those risks by answering the following questions:

- What threats and hazards can affect our community?
- If they occurred, what impacts would those threats and hazards have on our community?
- Based on those impacts, what capabilities should our community have?

Stakeholder Preparedness Review

The SPR is a self-assessment of a jurisdiction's current capability levels against the targets identified in the THIRA. Jurisdictions identify their current capability and how that capability changed over the last year, including capabilities lost, sustained, and gained. Jurisdictions also identify capability gaps related to planning, organization, equipment, training, and exercises, and indicate their intended approaches to address those gaps while maintaining their current capabilities. In addition, jurisdictions identify how FEMA preparedness grants helped to build or sustain capabilities.

Local chemical industries will also have performed their own risk assessments for their operations and facilities. Additionally, many facilities are required by EPA regulations to develop a risk management plan (RMP). Jurisdictions should take advantage of any additional information they can gain from such plans when developing their own response plans. For example, the chemical sector can and often will rely on private sector response teams such as CHEMTREC®[1] to provide them with information, guidance, and response support during chemical incidents. Knowing which chemical facilities/transporters in the area plan for assistance from these kinds of private response entities will aid the jurisdiction in assessing their risk and further response needs.

What Will You Need to Know?

- ☐ What and where are the industrial, agricultural, and transportation facilities?
- ☐ What is known about local terrorist activity and desired targets?
- ☐ What and where are the local capabilities such as people and material resources?
- ☐ What are the local processes, competencies, and decision-making systems?
- ☐ How do I contact the State or Tribal Emergency Response Commission (SERC or TERC) and the Local or Tribal Emergency Planning Committee (LEPC or TEPC)?
- ▪ What documents do they have in hand that can be leveraged for planning and/or response?
- ☐ What large-scale chemical-using industries operate in your region?
- ▪ What chemicals do they use?
- ▪ What are the hazard characteristics of those chemicals?
- ▪ Which of them relies on response assistance from private entities such as CHEMTREC®?
- ☐ What large-scale chemical transportation providers operate in your region?
- ▪ What are their routes?
- ▪ What are common chemical cargoes and amounts?

[1] CHEMTREC® is a registered service mark of the American Chemistry Council, Inc.

2.3. Critical Infrastructure

Developing a baseline knowledge and record of regional critical infrastructure assets and characteristics will help create a pre-incident inventory of vulnerable critical infrastructure and key resources. Data and expertise from the following sources can be leveraged to support community preparedness when identifying local key infrastructure:

- Homeland Infrastructure Foundation-Level Data (HIFLD), which provides infrastructure geospatial information
- Department of Homeland Security (DHS) Cybersecurity and Infrastructure Security Agency (CISA) Protective Security Advisor (PSA) program, which provides critical infrastructure protection and vulnerability mitigation SMEs and can link the jurisdiction to CISA's infrastructure protection resources and services

Once the critical infrastructure and key resources that are vulnerable to chemical incidents have been identified, temporary alternative infrastructure solutions (transportation, water, energy, communication) can be explored. These alternatives can be activated when primary systems or access/delivery routes are unavailable or overwhelmed. For example, plans can be made for the provision of an alternative water supply. Implementation of these plans would immediately reduce the public's exposure to contaminated household water and could be continued until local authorities can provide a permanent remedy.

FEMA's Community Lifelines construct may be helpful in organizing infrastructure threat and hazard identification and risk assessments. Lifelines describe the critical services within a community that must be stabilized or re-established to alleviate threats to life and property, and include water, energy, communications, and transportation. Community lifelines frame incident information to provide decision- makers with impact statements and summarize the root causes of disruptions to lifeline services. Utilizing the lifelines construct for preparedness and protection should work to maximize the effectiveness of key infrastructure restoration activities when an incident occurs.

What Will You Need to Know?

- ☐ What are the asset names and locations?
- ☐ What critical services are provided by each asset?
- ☐ What are the dependencies between services and assets?
- ☐ What are the workaround capabilities for services provided by each asset?
- ☐ What are the milestone requirements for services and assets?

Figure 27: FEMA Community Lifelines

A pre-incident prioritization of critical infrastructure restoration should also be created based on the inventory of regional critical infrastructure assets and characteristics. Such prioritization is important since re-establishing critical infrastructure within the affected areas will support ongoing emergency response operations, life-sustainment, community functionality, and a transition to recovery. Pre-established plans can be generated based on existing plans for infrastructure prioritization, and can be tailored for specific chemical release incidents. These plans should include milestone requirements for restoration of high-priority services/assets given the benefits that result from the restoration of each critical service/ asset when it is made available again. The Community Lifelines construct should again be a useful tool in determining prioritization for the stabilization of fundamental services after an incident, with considerations for contingency response solutions as well as re-establishment of lifeline services.

The prioritization of the restoration of service of various elements of critical infrastructure should go beyond the level of "sector" (water, energy, communications, transportation) to also include the type of customer. In addressing the restoration of service, plans should also prioritize the re-entry (return) of essential personnel for critical infrastructure restoration purposes in situations in which widespread evacuations are needed due to a major chemical incident or a natural disaster with a wide area footprint. For example, hurricane-prone communities in Louisiana have codified plans for repopulation following a large-scale disaster that requires a mass evacuation. The re-entry plan of Jefferson Parish, LA, has tiers for which groups are allowed back: first, first responders; second, staff of primary critical infrastructure and major utility companies, and relevant government staff and contractors; third, assessment teams representing major companies and employers; fourth, economically vital and/or essential business owners and designated employees; and finally, the general public.

Coordination Opportunity

Prioritization methods should be developed by bringing together emergency planners, executives, infrastructure owners, and other private and public stakeholders in neighboring jurisdictions to consider and negotiate restoration objectives and priorities. The framework provided by FEMA's Community Lifelines can facilitate these considerations.

The impacts of a wide-area chemical scenario on regional critical infrastructure and function can be identified, understood, and accounted for pre-incident. For example, contamination of a port area will disrupt shipping and transportation functions. A pre- incident plan for assessing the nature and extent of critical supply chain disruptions as well as their potential impacts on manufacturing, agriculture, and energy facilities' operations, including distribution of their products (e.g., electric power, fuels), should be developed. This activity should begin with identifying supply chains for critical resources and potential chemical release-based interruption points of those supply chains.

Good response planning must consider the issues, operational realities, and constraints facing the emergency response capabilities in each community. Based on its own circumstances, each community may reasonably adopt different response strategies based on the same technical analysis.

Refer To

DHS's Supply Chain Resilience Guide (April 2019)

Action Item

Perform a locally-tailored chemical risk assessment and key infrastructure inventory that includes:

- Inventory of local industrial, transportation, and agricultural facilities
- Inventory of potential terrorist threats or targets
- Inventory of vulnerable critical infrastructure/key resources (transportation, energy, water, communication, healthcare/medical services)
- Temporary alternative infrastructure solutions (transportation, energy, water, communication, healthcare/medical services) to be implemented when primary systems or routes are unavailable or overwhelmed
- Prioritization of critical infrastructure restoration

- Assessment of potential critical supply chain disruptions in the manufacturing and agriculture sectors as well as Community Lifelines infrastructure such as water, energy, communications, and transportation

2.4. Population Considerations

Community populations are heterogeneous; protecting the lives and property and meeting the needs of all groups during the response to and recovery from a chemical incident will require the development of multiple and/or flexible strategies. Building heterogeneous stakeholder working groups that reflect and represent the community's diversity will help ensure that short- and long-term needs are met population-wide.

To effectively protect and provide support to the whole community, chemical incident response and recovery strategies must consider the needs of all populations. This includes traditionally undervalued, underrepresented, and underserved (U3) populations such as the elderly, disabled, non-documented, and homeless; those impacted by the digital divide; those with limited English proficiency; racial and ethnic minorities, LGBTQIA+ (lesbian, gay, bisexual, pansexual, transgender, genderqueer, queer, intersexed, agender, asexual, and ally) communities, etc. In addition, strategies should include considerations for non-traditional community groups that live, work, and gather in the community, workers from other towns, visitors, and people commuting to schools.

Stakeholder groups with diverse membership will bring perspectives from across the whole community to the development of protection and support strategies. These perspectives will inform strategies for meeting population needs in areas such as:

- Chemical incident education campaigns
- Public communications and messaging
- Shelter-in-place and evacuation logistics support
- Mass care and sheltering support
- Health care
- Mental and behavioral health care
- Access to food, emergency first aid, and emergency items
- Resources and services to support individuals with disabilities
- Resources and services to support individuals with limited English proficiency, transportation challenges, and other needs
- Resources and services to support children
- Resources and services to support household pets and service and assistance animals
- Long-term economic support
- Long-term housing support

Protection and support strategies for the whole community following a chemical incident are discussed throughout the rest of this document. In particular, strategies for understanding your community's various population components are discussed in KPF 3, Communicate with External

Partners and the Public, and strategies for meeting mass care needs are discussed in KPF 5, Augment Provision of Mass Care and Human Services to Affected Population.

Coordination Opportunity

Build a coalition of decision-makers, emergency response, community leaders, and public and private partners in business, communications, housing, mental health, public health, medical care, education, etc. in your community. Discuss chemical incident-specific concerns and questions with people across population segments.

Action Item

- Identify populations with specific accessibility, messaging, and operational needs, and develop strategies to address those needs during chemical incident response and recovery
- Work with community groups to ensure plans are inclusive, and are based on a diversity of opinions and have been checked for unintentional bias
- Become familiar with state, regional, and local plans for mass care and human services
- Determine requirements for, and sources of, the resources needed for mass care and human services after a chemical incident

What Will You Need to Know?

☐ What traditional and non-traditional groups and special populations live, work, and gather in the community?

☐ What accommodations will be made for individuals in need of additional response assistance? How?

- Populations with disabilities?
- Populations living in institutional settings?
- The elderly?
- Populations from diverse cultures, or who have limited English proficiency, or who are non-English speaking?
- Children?
- Populations with transportation challenges?
- Populations in need of crisis counseling?
- How will the care of household pets and service animals that arrive with their owners be accommodated?

- ☐ What are the pertinent Memoranda of Understanding (MOUs)/Memoranda of Agreement MOAs) required to facilitate services in the aftermath of a chemical incident?
- ☐ What are the reunification plans for daycare centers, schools, businesses, etc., in your region?

2.5. Resource Requirements and Sources

The response to and recovery from a chemical incident may require more and different resources than are commonly available within any given local jurisdiction. Timeliness in obtaining the full measure and range of resources needed will directly impact the effectiveness of response and recovery activities. Advanced planning, therefore, is needed to identify requirements for a timely and effective response to and recovery from a chemical incident, as well as the suppliers of required resources and the timelines within which they will be needed. Such resources include (but are not limited to):

- Sampling kits/monitoring, detection, and identification equipment
- Personal protective and other specialized equipment
- Decontaminants and deployment equipment
- Livestock/poultry depopulation equipment
- Protective action equipment
- Access to laboratory analysis capabilities (and procedures for usage)
- Specialized medical equipment and training, treatments, and pharmaceuticals
- Technical support personnel trained in HazMat and/or to OSHA standards

Advance planning will help communities identify resource requirements, determine resource shortfalls, and develop a list of needs that private suppliers or other jurisdictions might fill. Local officials must then engage with those suppliers and supporting agencies and other jurisdictions to ensure the ready availability of the needed resources should an incident occur. The Emergency Management Assistance Compact (EMAC), a national all-hazards mutual aid compact, can also be called upon during declared states of emergency or disaster to gain access to essential resources. EMAC provides an avenue for other states to send personnel, equipment, and supplies (including National Guard) to assist with response and recovery efforts. Jurisdictional plans should account for unsolvable resource shortfalls so they are not just “assumed away.” Such shortfalls might be addressed via local government or market incentives that encourage further development of resource capabilities and realistic response measures.

Action Item

Develop an inventory of response and recovery assets/resources for a chemical incident by:

- Developing a list of required material resources, personnel, healthcare resources, processes, and competencies that consider chemical hazards in the area and appropriate remediation options
- Identifying sources of required personnel and equipment
- Developing a plan to identify resource capability gaps and exploring alternatives to fill them
- Developing agreements and protocols to obtain necessary resources in an incident

Figure 28: Achieving recovery outcomes will require a large amount of resources, including trained personnel, PPE, decontamination equipment, and laboratory analysis capabilities

2.6. Treat the Community's Entire Response System as a System of Systems

Treating the community's entire emergency response system as a system of systems will help community decision-makers understand the interdependency of community relationships, resources, and components for a successful response. To mount the most effective response to a chemical incident, communities need to understand the essential components of the overarching emergency response system and their priority interdependencies. Further, communities need to understand that the emergency response system includes a variety of local stakeholders, including the traditional emergency responders and hospitals; other groups with HazMat response capabilities; non-traditional private sector and non-profit disaster relief and assistance organizations such as Voluntary Organizations Active in Disasters (VOADs); and related out-of- area assets, including EMAC and state and federal assets. A systems engineering approach will help avoid over-estimating resources trained, equipped, and available (for example, when emergency medical services (EMS) workers are also volunteer firefighters), and identify the potential for cascading failures. It will also

3. Understand How Time-Sensitive Decisions Are Made in Crisis Situations

In a chemical incident, as is the case regarding many other types of emergencies, delayed decisions lead to more casualties and consume more resources. The reasons for delayed – and poor – decision-making are often attributable to incomplete, inadequate, or incorrect information, or to the inability to understand available information. To improve the efficiency and effectiveness of a chemical incident response, communities need to understand how time-sensitive decisions are made in chaotic, ambiguous situations and form partnerships with experts that can make chemical incident-related information understandable.

Decision-making will need to balance political/social priorities and public health protection against time and cost constraints.

3.1. Establish Decision-Making Processes

Response and recovery operations following a large-scale release of a toxic chemical have the potential to be time-consuming and complex. Early in the response, when situational awareness is rudimentary and information gathering is ongoing, decision-making processes will face many obstacles.

Therefore, the pre-established stakeholder working groups should identify the key decisions that will need to be made, the minimum information needed to make those decisions, and potential sources for this information. Default response actions should be developed to use when event-specific information is not available. Advance planning for decision-making processes can facilitate response and recovery activities so that, once community lifeline stabilization activities are complete, normal community life can resume.

Decision-making processes should be established to select among available options for (a) evacuation or shelter-in-place, (b) decontamination/environmental remediation, (c) waste management, and (d) clearance determinations (see below), taking into consideration many complex and competing factors, including clearance goals, health risks, resource availability, costs, timelines, and waste generation. The processes will need to balance political/social priorities and public health protection against time and cost constraints, and, therefore, should include discussion of reimbursement/ compensation for resources provided and contingencies if resources are damaged, destroyed, etc.

Action Item

Establish decision making processes that include:

- Key decisions that will need to be made, the minimum information needed to make those decisions, and potential sources for this information
- Default response actions to use when event-specific information is not available

3.2. Evacuation/Sheltering

For some chemical incidents, people may need to evacuate or shelter-in- place to prevent them from being exposed and/or contaminated. Making a recommendation for sheltering or evacuations is not always easy, even when relevant information is available. Many factors are involved in these decisions, including geography and topography, population density and location, and water movement or prevailing winds, in addition to the characteristics of the released substances. Then, processes for determining safe distances, devising evacuation procedures, and developing comprehensive emergency public communications strategies will require focused consideration.

Authorities should plan strategies to transport individuals to evacuation/shelter sites and for staffing such sites. Sheltered individuals must be ensured adequate food, water, sanitation, medical care, and protection from the elements when extended (multi-hour) sheltering-in-place is warranted. The needs of evacuees will be greater and require complex and detailed planning. Most of these needs will be similar to those for evacuees from natural disasters; however, the potential need for decontamination of evacuees in chemical incidents must be considered and planned for. (See also KPF 5, Augment Provision of Mass Care and Human Services to the Affected Population for further considerations, such as staffing services in a chemical incident.)

3.3. Decontamination and Population Monitoring/Environmental Remediation

Plans for mass decontamination of survivors and their pets prior to their transport and/or entry into medical facilities are extremely important in a chemical incident, as emergency decontamination may be an essential part of life-saving first aid. Plans should include protocols and procedures for the decontamination of patients before hospital admittance, an important step in preventing the contamination of health care workers and facilities. To protect environmental health and to control chemical spread, chemical incident emergency management protocols must also include procedures for choosing appropriate chemical containment and environmental remediation methods. First responders, their vehicles, and their equipment will also need to be decontaminated. Advance planning for the decision-making process can help ensure that decontamination, containment, and remediation decisions are based on the best available data and have the overall goal of protecting human and environmental health while minimizing the overall time and cost of response and recovery (and waste generated, see below).

EPA can provide access to resources detailing remediation, decontamination, and containment techniques, procedures, and equipment that may be needed. Further, EPA’s Consequence Management Advisory Division (CMAD) can provide expertise during decontamination/remediation planning as well as during the establishing of clearance goals (below). Specialized personnel, supplies, and equipment will be needed for decontamination, containment, and remediation; sourcing for these requirements is discussed above. Decontamination and remediation strategies are discussed further in KPF 4, Control the Spread of Contamination, and in Appendix H.

3.4. Waste Management

Experience has shown that in major incidents, most of the elements of the waste management plan will be the same and that the most time intensive elements – identification of regulatory requirements, waste characterization, and identification of waste management facilities and assets – can best be planned well in advance of any given incident. Wide-area chemical waste management plans can be patterned after existing plans for disposal of hazardous waste and extended to cover waste contaminated by chemical substances and their decontamination break-down products, including agricultural and animal wastes as appropriate.

Understanding how a state regulates a specific chemical can have important impacts on and consequences for the activities undertaken during the response to and recovery from an incident. For example, the lack of an appropriate waste management facility to handle the disposal of the specific waste in a state may greatly influence the remediation strategy, timelines, and cost. Knowing this ahead of time allows for the identification and validation of regional solutions for waste disposal. U.S. Department of Agriculture (USDA) coordination with national waste management associations may enable national-level agreements surrounding issues unique to large animal agriculture incidents.

Clearly, predetermining disposal options for managing, transporting, and disposing of large volumes of contaminated materials is essential to mount an effective and efficient response and recovery. However, the process of planning out these options may require significant time and detailed discussions with the facilities and entities involved. Solutions may include establishing staging sites, treatment options, exceptions to regulatory requirements, transportation options, and disposal options. EPA's CMAD may be able to help jurisdictions develop a waste management response and recovery plan and provide needed capabilities during a large-scale incident.

What will you need to know?

- ☐ What are the federal, state, local, tribal, and territorial waste management requirements?
- ☐ What are the types and quantities of waste anticipated (including animal waste and carcasses)?
- ☐ What are the waste management facilities/assets and resources needed?
- ☐ What are the waste transportation requirements?
- ☐ What are the waste management oversight activities?
- ☐ What are the solutions to potentially limited disposal capacity?
- ▪ What are the waste disposal sites beyond the region if excess capacity in needed?
- ☐ How can waste management services contractors or mutual aid agreements be established?

Action Item

Develop a pre-incident waste management strategy that includes:

- Sampling and analysis plans of waste streams
- Considerations for animal waste materials and carcasses
- Waste/material tracking and reporting systems

- A waste management community outreach and communications plan
- Concise risk communications to the public (on such topics as the danger of illicit dumping, for example)
- Plans for the continuation of normal household or commercial waste collection and disposal services during the response (when waste management resources will be devoted to the management of wastes generated from the chemical incident)

3.5. Establish Clearance Goals

Clearance goals are goals or criteria for human or release site cleanup, decontamination, and/or remediation. They describe the amount of residual chemical remaining in an area, on an item, or on a person, following cleanup activities that is deemed to provide "acceptable" protection to human and environmental health. The goals are used to set clearance criteria, which are measures that serve as the basis for determining whether re-entry/re-occupancy into an area, re-use of an item, or entry into medical facilities is allowed. Clearance criteria are set based on public health, environmental health, political, social, economic, engineering, and other considerations, including available sampling strategies and decontamination technologies. "Clearance" of an area, item, or person indicates that these criteria have been met; residual chemical risks have been reduced to levels deemed acceptable.

The clearance goals represent a difficult trade-off between health risk concerns and regional economic recovery concerns. They are arguably the most significant drivers for the overall post-incident remediation process, strongly influencing the remediation timeline and the associated costs and resource requirements. If a chemical incident should occur tomorrow, it is important to have ready a set of well-understood, defensible, health-protective exposure levels that can be assessed to develop appropriate and reasonable site-specific and chemical-specific clearance goals. During an actual incident, clearance goals established for pre-planning purposes must be considered alongside incident- and site-specific information and adjusted as necessary to establish formal clearance goals.

The selection of clearance goals is a complex process that requires input from technical experts and a review and understanding of data on a range of subjects, such as the chemical's physicochemical characteristics, health-based exposure guidelines, environmental conditions, composition and characteristics of the impacted areas, and other parameters. Major challenges include the absence of good dose-response data and disagreement among stakeholders regarding the adequacy of existing exposure standards.

Scientifically appropriate, well-characterized exposure guidelines must be used to ensure that human and environmental health are safeguarded without defaulting to overly conservative actions (such as cleaning/decontaminating to undetectable levels) that would divert limited resources without major benefits. For an actual contamination incident, site- and health-specific factors must always be considered, and a risk-based decision process involving key stakeholders must be used.

Guidance documents that provide the rationale for a reasonable and scientifically supported set of procedures and health-based criteria will give decision-makers maximum flexibility for weighing the numerous considerations that must be evaluated. Such considerations include the safety of decontamination personnel, public health and environmental health, time, funds, resources, and public perception, among others. Final decisions should be made by responsible site- specific authorities and should reflect considerations of acceptable risk and socioeconomic concerns. Timely and clear communication of exposure-based guidelines will help reduce public anxiety and improve the effectiveness and efficiency of post-incident response and recovery activities.

Action Item

Establish decision-making processes for response and recovery actions based on community and expert input, including:

- Resource allocations
- Chemical waste management
- Selecting among environmental remediation options
- Clearance goals specific to chemical incident remediation

3.6. Establish Protocols and Procedures for the Prioritization of Medical Resources

In emergency/mass casualty situations resulting from chemical release incidents, local health care providers will need to adjust their existing protocols for medical prioritization. For example, medical triage may be needed to prioritize moderately injured survivors over those that are unlikely to recover even with extensive treatment. Hospitals should plan for a surge of exposed patients and should consider establishing agreements with regional medical facilities to expedite the sharing of resources and transport of survivors to facilities with treatment capacity. Potential shortages in critical medical personnel, supplies, and equipment, as discussed above, may cause a need for prioritization of medical care beyond normal triage procedures. Any adjustments made to protocols and procedures, and the decision-making factors and personnel behind them, must be made transparent via careful public messaging to ensure continued public confidence during a resource-restricted response.

In addition to equipment and staff requirements, communities should also characterize emergency medical services (EMS) and hospital capabilities and capacities, as well as veterinary services, when planning for large-scale release and potential mass casualty incidents. To address potential shortfalls, planners may consider development of a robust all-hazards medical and veterinary surge plan, including the pre-incident identification of coordinating points that will be able to provide rapid reachback access to resources even when not on-scene, such as poison control and academic centers.

Coordination Opportunity

Relevant information for planning should be available via coordination with the local Hospital Preparedness Program (HPP)-supported health care coalition (HCC), in much the same way as industrial response needs are planned for in collaboration with LEPCs/TEPCs.

Action Item

- Establish protocols and procedures for the prioritization of medical resources
- Develop contingency plans with regional partners for provision of limited resources

4. Develop a "Whole Community" Concept of Operations

Emergency response planning requires a "whole community" concept of operations (CONOPS) that reflects the collected work of the stakeholder working groups and is coordinated with local elected leadership. A CONOPS that incorporates the input and resources of all essential elements of the response system allows for a coordinated, swift response, which is especially crucial during the early window of opportunity when most of a chemical incident's outcome is determined.

A community wide-CONOPS should be built that allows the community to assess its own level of preparedness and proficiency for each stage of response and recovery, pinpointing exactly where strengths and deficiencies lie. Planners can compare their level of preparedness against their community-specific chemical risk assessment (based on local threats and vulnerabilities) to align their current and planned capabilities with their greatest risks.

4.1. Develop Community-Wide and Partner Messaging Strategies

Public alert and warning play a vital role in minimizing additional exposures as critical response actions need to be rapidly communicated to a wide audience. During the planning process, the warning methods available (and their efficacy) and the critical information that needs to be provided should be identified. Emergency management planners should also consider investing in public information and family reunification capabilities, including the expansion of pre-scripted messages as part of the emergency alert system and formalization of the regional joint information system. These can be used to rapidly disseminate actionable information to the public even before the details of the incident are known (see KPF 3, Communicate with External Partners and the Public).

Action Item

Develop chemical incident-specific, accessible public and partner messaging and communication strategies by:

- Patterning after existing all-hazards communications plans
- Consulting with subject matter experts to develop chemical incident-specific, accessible message templates and protocols
- Developing agreements and protocols for obtaining real-time SME expertise in an ongoing incident

4.2. Develop Operational Plans/CONOPS and Response Support Materials

Pre-incident development of plans, procedures, and CONOPS to guide chemical response activities, and their testing via exercises, will work to ensure an appropriately coordinated and targeted response when a chemical incident occurs. Robust plans, procedures, and CONOPS will include consideration of:

- Existing hazardous materials release consequence management plan
- Decision-making environment faced by the first-responder community
- Essential elements of information (EEI) needed by first responders, transcribed into customized decision matrices for their use
- Operational and tactical materials that support decision-making analyses, and the provision of such tools, perhaps as decision matrices, to help first responders collect EEIs and make decisions
- Decision matrices that inform the determination of appropriate decontamination processes and a detailed personnel decontamination plan with both rapid and alternative decontamination processes
- Innovative methods to determine appropriate protective actions both in the immediate vicinity of and outside the chemical incident area
- A mind set of “an incident within an incident” that works towards developing alternative and continuity of operations plans

Action Item

Develop operational plans/CONOPS that adequately identify critical objectives, provide a complete and integrated picture of the sequence and scope of the tasks to achieve the objectives, and are implementable within the time frame contemplated in the plan using available resources

4.3. Develop and Deploy Training, Exercises, and Response Support Materials

Without repeated training and exercises, a coordinated and swift response, even utilizing a well-planned CONOPs, is unlikely to be successful. Promote community and responder readiness by developing chemical incident- specific training materials, executing chemical incident-specific training exercises, and distributing chemical incident-specific response guides, for example:

- Training programs to educate first responders on toxidromes associated with top threats
- Exercising decision-making under stressful conditions and with incomplete information
- Work aids, decision trees, and checklists for wide distribution, because high-consequence chemical incidents are infrequent
- Testing and exercising different messaging and communications formats and strategies
- Training for first responders and educational programs for the community on how to evacuate or shelter-in-place
- Training for first responders on supporting individuals with disabilities during response activities
- Advanced life support training for HazMat personnel, and HazMat training for first responders such as EMS and law enforcement personnel
- Training for personnel to Chemical Technician-level, OSHA 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER) standards
- Expanded capabilities for the regional HazMat team, including the linking of practice and technology solutions to encourage early event recognition

Figure 29: Members of the Presidio of Monterey Fire Department, Salinas Fire Department, and 95th Civil Support Team participate in a HazMat exercise

Action Item

- Develop local training programs that expand first responder and community capabilities, and exercises that adequately support and evaluate training programs and operational plans/CONOPS
- Develop response exercises with chemical facilities in the area

Refer To

- *Pre-Disaster Recovery Planning Guide for Local Governments* (February 2017)
- *Pre-Disaster Recovery Planning Guide for State Governments* (November 2016)
- *Pre-Disaster Recovery Planning Guide for Tribal Governments* (September 2019)
- *FEMA Developing and Maintaining Emergency Operations Plans, Comprehensive Preparedness Guide (CPG) 101*, Version 2.0 (November 2010)
- *Planning for Post-Disaster Recovery: Next Generation*

What Will You Need to Know?

☐ Presidential Policy Directive 21 (PPD-21) delineates 16 critical infrastructure sectors. Which ones are operational in your region?

- Chemical
- Commercial Facilities
- Communications
- Critical Manufacturing
- Dams
- Defense Industrial Base
- Emergency Services
- Energy
- Financial Services
- Food and Agriculture
- Government Facilities
- Healthcare and Public Health
- Information Technology
- Nuclear Reactors, Materials, and Waste
- Transportation Systems
- Water and Wastewater Systems

☐ Are there any infrastructure coordinating councils that need to be consulted for planning?

☐ How will critical infrastructure assessments be coordinated and conducted?

☐ How will you know the status of critical infrastructures?

- Critical infrastructure facilities?
- Critical infrastructure workforces?
- Critical infrastructure logistics?
- For each critical infrastructure listed above, what will you do to address issues such as workforce and/or resource limitations, or cleanup and/or remediation?

☐ Within healthcare and public health, how will you know the status of critical services facilities and their providers?

- Medical and public health?
- Behavioral health?
- Social services? How will you know about any supply chain logistics issues?

☐ How will you determine the status of SLTT operations?

- How will you mitigate actual or potential resource shortfalls of the affected state(s)?

☐ Are there existing regional agreements that will influence and/or inform your chemical incident planning efforts?

- What are the existing Emergency Management Assistance Compacts (EMACs) – national interstate mutual aid agreements that enable states to share resources during times of disaster – in your region?

☐ How do regional plans, including exercises and lessons learned, influence and/or inform your chemical incident planning efforts? Check the local and regional all-hazards plans for information on partnerships with entities for:

- Laboratory operations
- Field operations
- Public health operations
- Emergency management
- Law enforcement
- First responders
- Facility owners

What are the most vulnerable populations?

Daycare centers and pre-schools

Senior citizen centers, nursing homes, assisted living facilities

What are the locations of potential chemical incidents?

Industrial sites

Agricultural sites

Transportation sites

What are the local capabilities?

Trained Personnel

Healthcare/medical services

Decision making systems

Waste management

What are the locations of critical infrastructure?

Energy sector

Transportation sector

Water and wastewater systems

Communications sector

Emergency services sector

Food and agriculture sector

Healthcare and public health sector

Government facilities sector

KPF 2 Recognize and Characterize the Incident

Timely recognition and accurate characterization of a chemical incident are key components of an effective response. Early recognition saves lives and protects property and the environment by enabling speedy treatment of the injured, containment of the release, interventions to limit the spread of contamination, and possibly preventing a follow-on incident. Accidental chemical incidents are often reported by the Responsible Party; however, they may also be detected through human health surveillance systems and environmental monitoring, barring the presence of an overt indication (e.g., a detectable odor or taste, intelligence, an eyewitness to a release, a cluster of unusual health effects). Historically, chemical attacks have gone unannounced, leaving the response community to decipher that an attack occurred and essential details of its nature and extent.

The KPFs described in this document apply to response and recovery activities for all types of chemical incidents. The Prologue presented a small selection of the chemical and scenario types possible, ranging from releases caused by industrial and transportation accidents, to agricultural production and storage incidents, to terrorist attacks and accidental and intentional poisonings. Populations affected by these event types also varied from a handful of individuals to entire towns and regions. The chemicals released and the release sites were different in every case, but commonalities exist in response and recovery strategies across these scenarios. This KPF focuses on the need to first recognize that an incident is occurring or has occurred and gather information about the release event. It also discusses common strategies for characterizing and conducting an initial assessment of the event.

1. Incident Recognition

The first step in an effective response is recognizing that a chemical incident is occurring or has occurred. While most chemical emergencies in the U.S. occur as a result of accidents or technology failures, they may also occur as a result of deliberate acts or as a result of a natural disaster.

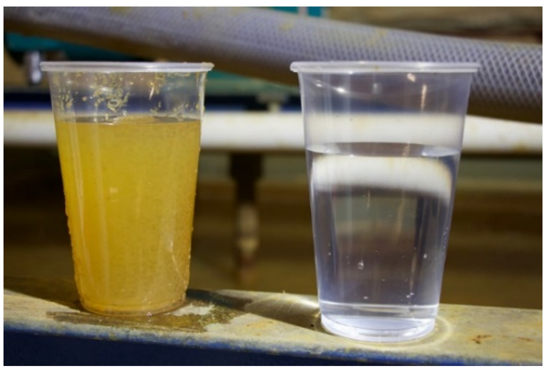
Sectors that routinely use and/or transport toxic industrial chemicals and materials have chemical detection systems in place for the protection of their workers and the local environment. Owners and operators (also called “Responsible Parties”, RPs) of chemical facility sites and/or transportation systems bear the primary responsibility for their security and safe operations and are obligated to provide critical notification and first- response in the event of a chemical incident.

In some cases, however, RPs will not be the first to recognize that an incident is occurring. In the case of intentional chemical attacks, there may be no associated facility to help with event recognition. In the absence of incident notification from an RP, including malicious acts, incident recognition can occur in a variety of ways, including via both active detection systems/technologies and passive recognition systems/ surveillance activities that monitor individuals and populations for chemical exposure signs and symptoms.

Active and passive recognition of a chemical incident

Chemical detection systems, such as those found at high-traffic venues or public service utilities

Obvious explosions or transportation accidents



Public notice of unusual colors, taste, or activities

Humans and/or animals exhibiting chemical exposure symptoms

Unfortunately, the initial recognition of a chemical incident via passive surveillance is often slow, and characterization of the incident is challenging, especially regarding the identification of the specific chemical involved. For example, the Prologue describes a chlorine release during daylight hours, when facility employees could immediately recognize the large chlorine cloud emerging from the rail tanker (and respond to facility detector alarms).[12] However, more than an hour was needed to identify that chlorine was released during a train derailment that occurred during the night.[21]

Figure 30: Recognition of a chemical incident can be slow and challenging without adequate detection systems. Left, chlorine cloud released by a rail accident during the day. Right, rail accident that released chlorine during the night.

The initial recognition and characterization of a chemical event are activities essential to limiting the harm caused by the release. Therefore, a combination of chemical detection systems, analysis of human health effects, signs in nearby animals, and other observable features of a release should be employed in communities. This KPF discusses active monitoring/ detection strategies for chemical incident recognition along with passive/ surveillance recognition strategies.

What would you do?

...if a dozen dead birds are found near a truck accident site?

...if 20 people complain of tingling in the mouth after eating at a fast-food restaurant?

2. Active Environmental and Industrial/Utility Facility Monitoring

For many facilities using, producing, and/or storing harmful chemicals, leak prevention and active detection systems are recommended by industry guidelines as best practices. In addition, there are numerous legislative and regulatory requirements that govern the monitoring and reporting of hazardous substance releases by RPs; these are discussed in Appendices C and D. Briefly, for facilities that handle hazardous substances, serve as “point source” dischargers of pollutants into bodies of water, or are emitters of hazardous air pollutants, the EPA has implemented monitoring and reporting requirements under the Emergency Planning and Community Right-to- Know Act (EPCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Clean Water Act (CWA) and Clean Air Act (CAA). Active detection systems used to fulfill these requirements can range from simple visual inspections to automated, electronic data- gathering instruments, to sophisticated consoles and computer systems. Such systems may use liquid sensing cables, soil vapor monitoring, or emissions tests. Most include automatic leak alarms.[4] For example, the Prologue describes near-immediate detection of chlorine release from a rail tanker by the facility's chlorine gas sensors.[12] Similarly, telemetry data provided by a chemical plant's refrigerated trailers was used to predict the stability and potential for hazardous decomposition of reactive chemicals in the wake of Hurricane Harvey.[3] In most cases, facility detection systems will trigger an alert before enough harmful material has been released.

Other specialized facilities also regularly monitor for contaminants. For example, pursuant to the Safe Drinking Water Act (SDWA) and the EPA's Unregulated Contaminant Monitoring Rule (currently UCMR 4), local water systems must monitor for selected common contaminants of concern. Through this program, chemical releases may be detected downstream of their sources. However, since only a few chemicals are monitored, many incidents may go unrecognized. For example, the Prologue describes a chemical release that was not detected by the RP or by the downstream water treatment utility's monitoring system, as the leaked chemical was outside of that utility's normal testing regime; instead, the release was recognized via the public's noticing of an odor.[4]

Thus, although environmental monitoring systems can play an important role in incident recognition, they have limitations. Further, if the test results are not available in real time, releases may be recognized only retrospectively (unless there is a chronic leak). The most obvious limitations are the logistical, analytical, and cost constraints that preclude the widespread use of these monitoring systems. Additionally, most environmental and facility monitoring systems are specific to the chemicals being stored or processed on site, and cannot detect chemical hazards outside of the system's configuration. Intentional releases away from storage or processing plants or accidents during transportation also may not be recognized immediately.

Figure 31: Chemical contamination and environmental testing of the Aminas River (Colorado) following a mining wastewater spill

2.1. Chemical Detection Technologies for Active Recognition

Chemical detection (and incident notification) systems can provide early, high-confidence warnings in the event of a chemical release. These rapid warnings provide substantial benefits in situations where the chemical released can have an immediate impact on the health of exposed individuals. Detection systems also provide first responders with an awareness of the scale of the incident and the nature of the chemical hazards involved.

Chemical detection technologies can detect chemicals and record their concentrations. Hundreds of chemical detection technologies produced by dozens of manufacturers are available, covering a wide range of target chemicals, detector characteristics, and capabilities. Detectors vary in size/weight, the state of material they can measure (solid, liquid, or gas), the number and type of chemicals they can detect, and their operational simplicity, including their ability to operate continuously and autonomously. Some can detect unknown chemicals, alerting the user to the presence of a contaminating substance. The most robust technologies can repeatedly measure tens or hundreds of chemicals over a large area with great sensitivity, selectivity, and accuracy, often within seconds while also recording other relevant data; however, these highly sensitive instruments are often not transportable to a field site.

Figure 32: HazMat workers test a suspected hazardous site for chemical agents

Two types of detectors exist in terms of how data are analyzed and output provided: real-time field sensors, which provide immediate readings on site, and sampling devices, which collect/ store samples for follow-on analysis in a laboratory. The digital, instantaneous nature of field detector results is a major boon in chemical incidents when response time is of the essence, while laboratory analysis of collected samples may be critical to identifying an unknown released substance.

2.2. Workplace Exposure Monitoring

Many industrial sites have chemical detection and release surveillance systems that act as a first line of defense mitigate the potential for minor issues to develop into large- scale chemical incidents. Through the efforts OSHA and the National Institute for Occupational Safety and Health (NIOSH), worker health surveillance programs, including those for workers with the potential for chemical exposures in the workplace, have been put into place. These programs involve the use of environmental sensors within the workplace and/or biomonitoring programs to track chemical exposures in workers. Understanding the capabilities of these chemical release recognition systems and how the information they provide can be used to inform a response outside the facility perimeter is important for local chemical incident response planning.

Personal, handheld, and large area sensors may all be used in the workplace to monitor chemical levels in the work environment and chemical exposures in workers. Personal sensors are small, lightweight units that are attached to workers while they perform their duties. Although available real-time personal sensors are easy to use, they provide less and lower quality data than sampling devices for laboratory analysis. In general, they also provide coverage for fewer chemicals. Most personal real-time sensors are able to quantify between one and four chemicals, although a handful can measure up to ten or more.

Common chemicals detectable by these sensors include:

- Ammonia
- Carbon monoxide
- Chlorine
- Hydrogen cyanide
- Hydrogen sulfide
- Nitrogen dioxide
- Phosphine
- Sulfur dioxide

Handheld and large area detectors have the advantage of being able to measure the levels of tens or hundreds of chemicals; these could be real-time or laboratory sensors.

Data collected by chemical detector technologies in the workplace can be complemented by biomonitoring programs. Biomonitoring refers to a variety of methods that assess human exposure to chemicals by detection and quantification of the chemicals' biomarkers in different biological sample matrixes. These biomarkers can be the chemicals themselves, their metabolites, or the products of an interaction between the chemical and a target molecule in the body. Generally, biomonitoring in humans is accomplished using a variety of analytical methods like chromatography, mass spectrometry, and spectroscopy on urine, blood, or hair samples. Since these programs generally require off-site laboratory analysis, they are likely to be of little help in detecting acute chemical release incidents, although their ability to identify chemicals by type may be useful in determining the appropriate treatment for acute injuries, and in recognizing chronic worker exposures due to long-term chemical leaks. As with other testing programs, biomonitoring will only identify exposures to a usually limited list of chemicals; due to metabolic processes, the detection window post-exposure also may be limited.

2.3. Active Monitoring of Public Venues

For scenarios involving chemicals with delayed health effects, active recognition may be the only means of recognizing the event unless the release itself is observed by the public, venue employees, or law enforcement.

The release of a chemical warfare agent or toxic industrial chemical in high- traffic areas such as transportation systems/hubs, sites of cultural or historic interest, sports/ entertainment venues, houses of worship, theaters, amusement parks, etc. is a national concern. For example, crowds of commuters and generally open security environments make transit venues, particularly transit terminals, airport ticketing areas, and subway systems, very attractive terrorist targets. Aum Shinrikyo's 1995 attack in the Tokyo subway with the chemical warfare agent sarin demonstrates how vulnerable these targets are; the attack left 12 dead and affected thousands more.[22] Recognizing that open access facility types represent potentially attractive targets, many such venues employ some variety of active chemical detection system. Such systems enable a coordinated, well-executed and quick response to a suspected chemical attack and can greatly limit the spread of the chemical substance and the resulting casualties. However, if the incident involves a chemical that is not one of those detected by the venue's system, the incident may go unrecognized, or may require passive/ surveillance systems to facilitate incident recognition.

2.4. Active Monitoring for Food Contamination

Hazardous chemicals can enter the food system by natural incursion, accidental introduction, or an intentional criminal or terrorist act, during food processing, storage, transportation, distribution, or preparation prior to consumption. Contamination of food with the possibility of widespread distribution and consumption by households across various communities has the potential to result in a catastrophic incident with a widely distributed number of casualties.

Food producers, FDA, USDA, and state regulatory agencies test foods for chemical contamination; however, testing capacity and ability are finite. The FDA inspects food processing, packaging, and distribution facilities, while monitoring of meat and egg production, such as in slaughterhouses, packing plants, etc., is handled by the USDA. Even so, recognition of adulterated food sources is challenging. The FDA monitors for a limited number of toxins, pesticides, and contaminants, in particular, industrial chemicals such as dioxins, cooking- or heating-related chemicals such as acrylamide, chemical contaminants such as benzene, dioxins and PCBs, ethyl carbamate, furan, perchlorate, and radionuclides, and metals.[23] The list of contaminants that the USDA screens for also is limited. Via the National Residue Program (NRP), an interagency program designed to protect the public from exposure to harmful levels of chemical residues in products, the USDA tests meat, poultry, and egg products for approved (legal) and unapproved (illegal) pharmaceutical (veterinary) drugs, pesticides, hormones, and environmental contaminants. In addition, the USDA monitors for potential linkages between chemical contamination in live animals and in food products, such as when agents of chemical warfare/ terrorism, toxic industrial chemicals, or other chemical contaminants are suspected in an animal-based food product or are found in livestock or poultry.[24]

Testing by FDA, USDA, state regulatory agencies, and food processors is limited and may not prevent a particular contamination event from affecting the public, unless the food's contaminant level is so high as to change its physical characteristics (for example, by changing the color, imparting an odor, oxidizing it, or changing its fluidity). In addition, as discussed above, many incidents may not be recognized via testing since only a few chemicals are monitored. Realistically, food contamination events are more likely to be recognized via other strategies (such as food facility personnel observations or syndromic surveillance, discussed below).

Figure 33: Hazardous chemicals can enter the food system at any stage of food processing, storage, transportation, distribution, or preparation

2.5. Active Monitoring for Illicit Compounds

Emergency responders, law enforcement, emergency medical services, firefighters, and healthcare personnel are all at risk of exposure to fentanyl and other illicit drugs in the course of their work. NIOSH is working to provide guidance for preventing workplace exposure and developing methods to facilitate opioid detection and decontamination. Recently, handheld detectors for narcotics (including opiates, cocaine, and amphetamines) have come to market. However, until their ability to accurately detect small amounts of illicit compounds is much improved, their detection time is immediate, and their use is widespread, syndromic surveillance (e.g., opioid toxidrome) followed by laboratory confirmation from blood and/or urine samples remains the most likely route to recognizing illicit drug exposures. Although it does little to protect these workers from on-the-job exposures, laboratory analysis of pharmaceutical ingredients in samples taken by first responders can also identify drug exposures.

3. Surveillance/Passive Venue and Population Monitoring

When the chemical released is not a type that is actively monitored by facilities/venues, recognition of a chemical incident will likely involve both the observation of something out of the ordinary and the communication of this observation to individuals capable of initiating a response. In some instances, this will result from field intelligence and investigations of threat reports of unusual or suspicious activities.

Event recognition via surveillance systems, then, involves the manifestation of health effects and the ability to recognize these effects as unusual. In particular, event recognition via surveillance systems requires syndromic surveillance and epidemiological investigations of unusual or suspicious symptoms in humans and animals.

Syndromic surveillance signs that a toxic event may be in progress include an unusually high number of people seeking medical care coincidently. Depending on the speed and severity at which the health effects manifest following exposure, a chemical incident could result in a surge of 911 calls and hospital admissions, an increase in over-the-counter sales of specific medications, and/or high volumes of Internet searches for specific symptoms.

3.1. Surveillance/Passive Monitoring of Public Venues

In public areas, an attack or its immediate preparations may be sufficiently unusual as to be noticed by the general public or venue employees. Signs that may indicate a chemical event may be in progress are:

- Unattended or otherwise suspicious packages
- Visible aerosol or gas clouds
- Patron actions, including complaints and spontaneous evacuation

Following the release of some types of chemicals (for example, the nerve agent sarin, as discussed above), near immediate human health effects will be seen, making the recognition that an adverse event is occurring relatively straightforward (even though the specific chemical involved may not be known). However, releases of smaller volumes or exposures to slower-acting substances (e.g., thallium via ingestion), where considerable time could elapse before individuals develop symptoms, may not be immediately obvious. In such cases, it may be the venue employees that are the first to experience symptoms as they remain within the area and are exposed for a much longer duration than typical patrons. Beyond event recognition, delayed effects also create challenges with contamination control: many seriously exposed patrons will likely have departed the area of exposure prior to symptom onset. In this case, reports of widespread adverse health effects may occur.

Figure 34: Recognition of a chemical incident may rely on observation. Noticing a pattern of clinical signs in humans or animals can be key to initiating investigations that lead to incident recognition.

3.2. Human and Veterinary Health Surveillance Systems

Given the immediacy of the danger posed by many types of chemicals, systems that collect and analyze data on the patterns of illness in a population generally will be too slow to act as an event "detector" in most chemical incidents. However, in some cases, such as heavy metal poisoning or pesticide exposure in agricultural workers, clinical recognition of a pattern of clinical signs and symptoms can be key to initiating investigations that lead to incident recognition.

Table 1: Indicators of a Possible Chemical Incident (Passive Detection/Surveillance)[25]

Indicator	Description
Dead Animals, Birds, or Fish	Numerous dead animals, wild and domestic, small and large, and in the same area.
Lack of Insect Life	Normal insect activity (ground, air, and/or water) is missing. Numerous dead insects on the ground, water surface, and/or shoreline.
Different-Looking Areas	Trees, shrubs, bushes, food crops, and/or lawns that are dead, discolored, or withered (with no current drought).
Unexplained Odors	Smells unusual for the area, including fruity to flowery, sharp/pungent, garlic/horseradish-like, bitter almonds, or mown hay.
Low-Lying Clouds	Low-lying clouds or fog-like conditions that are not consistent with surrounding or current weather conditions.
Unusual Liquid Droplets	Numerous surfaces exhibiting oily droplets or films, including water surfaces (with no recent rain).
Unusual Numbers of Dying or Sick People (Mass Casualties)	Health problems including nausea, disorientation, difficulty in breathing, convulsions, localized sweating, conjunctivitis, erythema (reddening of skin), and death.
Pattern of Casualties	Casualties will likely be distributed downwind (if indoors, by the air ventilation system) or downstream.
Blisters/Rashes	Numerous individuals experiencing unexplained blisters, weals, and/or rashes.
Illness in Confined Areas	Different casualty rates for people working indoors versus outdoors, dependent on where the agent was released.
Unusual Debris	Unexplained bomb/munitions-like material, especially if it contains a liquid.

In general, human and veterinary health surveillance systems monitor for aberrations in characteristic illness and injury presence and patterns such as injuries or illnesses occurring in unusual numbers, unusually clustered, or presenting unusual symptoms. These systems rely on the collection, analysis, and interpretation of health-related data such as traditional case-report data describing injury patterns that may present a public health threat and in-person investigations conducted by public health officials. While recognition and interpretation of clinical signs and symptoms as well as patient accounts may provide the critical information needed for the identification of the toxic material, exposure route, and exposure location this information may come too late to enable well-informed medical treatment or to prevent other individuals from becoming exposed. In cases where the chemical release is not effected in a single burst, these systems may play a critical role in identifying the source of an ongoing public health threat, such as a leak into a waterway, or contamination of the food supply.

Syndromic surveillance systems track indicators that occur before clinical diagnosis, such as chief complaint data from urgent medical visits, over-the-counter medication purchases, and key word (e.g., “itch”, “vomit”) presence on social media platforms. Commercially available systems that monitor 911 call data (i.e., FirstWatch) can enhance syndromic surveillance and situational awareness in communities in real time, as the 911 center is often a jurisdiction’s first opportunity to recognize a toxidrome based on information from callers, social media reports, etc. Such systems will be a boon to jurisdictions as the nation progresses through implementation of Next Generation 911 (NG911). Surveillance-based incident recognition can also be supported by members of the community other than first responders and health care providers. For example, schools with teachers/staff trained to be aware of unusual behaviors, sickness, absenteeism, or comments regarding health status in their neighborhoods, can play key roles in event recognition. Mortality surveillance and unusual death reporting also play roles in chemical incident recognition. Although the information tracked by these various systems may provide the first indication that an incident has occurred, the timeliness of the information provided varies based on the data sources used and how they are analyzed. In some cases, the information is very current, whereas others have data that are weeks old. Syndromic surveillance works best when all involved are aware, alert, and reporting activities in their areas.

Unfortunately, many chemical injuries start with vague symptoms and require additional testing to definitively determine the cause. Laboratory results that conclusively identify the chemical may not be available for days, and diagnostic and screening methods for particular chemical substances may not be attainable.

One example of a worker health surveillance program is the close monitoring of pesticide exposures in the agricultural sector by NIOSH via the Sentinel Event Notification System for Occupational Risk (SENSOR)-Pesticides program. This program monitors trends in pesticide-related illnesses and injuries and is therefore useful for identifying emerging pesticide-related problems. Currently, 13 states participate in the program; these states require physicians to report confirmed and suspected cases of pesticide-related illness and injury to state health authorities. Besides identifying, classifying, and tabulating pesticide poisoning cases, states periodically perform in- depth investigations of pesticide-related events and develop interventions aimed at particular industries or pesticide hazards. Although this system is useful for identifying chronic exposures, it does not collect data on a timescale useful for guiding the response to an emergent event.

Due to the immediate need to limit ongoing exposures in chemical incidents, recognition of chemical intoxicant-specific syndromic symptom patterns (toxidromes, see following page) therefore should be incorporated into all components of the emergency response system, starting with training and educational programs. The ability for first responders to quickly recognize the signs and symptoms of chemical intoxication should decrease alert and assessment time even in the absence of chemical identification, thereby increasing response efficiency and potentially saving lives.

Action Item

Ensure that all components of the emergency response system are trained to recognize chemical toxidromes, including trainings for:

- 911 and other public safety answering point (PSAP) staff
- Doctors, nurses, and other hospital healthcare staff
- Emergency medical service (EMS) providers
- Police and firefighter first responders

The USDA's Animal and Plant Health Inspection Service (APHIS) Veterinary Services (VS) National Animal Health Surveillance System (NAHSS) provides the tools necessary to recognize the presence of chemical substances that could affect animal health.[26,27] For scenarios in which livestock are exposed to a hazardous material, veterinary surveillance systems such as this may be the first to recognize that an incident has occurred. In such cases, communication between veterinary and public health communities is essential for chemical incident recognition. However, this communication is likely to be delayed, as it will take time for veterinary diagnostic and reporting chains to meet requirements for providing notification to public health officials. For example, if the veterinarian called in by the livestock producer cannot identify the chemical substance, they will require assistance from a state veterinarian and/or order toxicological screening tests. The state veterinarian would then report the incident to the USDA and other authorities. Again, the timeliness of data collected by veterinary surveillance systems and any forthcoming communication with public health officials varies and is in general unlikely to be fast enough to prevent further harm to human and animal health.

Coordination Opportunity

Veterinary and public health communities should share surveillance results to aid chemical incident recognition.

3.3. Surveillance for Food Contamination

In general, the recognition of a chemical incident resulting from food contamination will occur via syndromic surveillance as discussed. In addition, signs that a food event may be in progress include the occurrence of symptoms in unrelated, widespread groups. Symptoms caused by food contamination may not be contained to a single geographical region due to the often-broad distribution of food items and potential for people to travel after purchasing or eating contaminated food.

A national example of a syndromic surveillance system is the CDC's National Outbreak Reporting System (NORS), which collects reports of disease outbreaks caused by chemical agents, including those spread through food, from SLTT public health agencies. On a more local level, the National Poison Data System (NPDS), a combined effort of the American Association of Poison Control Centers (AAPCC) and the CDC, aims to help local poison control centers detect chemical exposure events.

Table 2: Chemical Toxidromes

Toxidrome*	Description and Example Chemicals
Solvents, Anesthetics, or Sedatives (SAS) Toxidrome	▪ Central nervous system depression evidenced by a decreased level of consciousness (may progress to coma), depressed respirations, and ataxia (difficulty balancing and walking). ▪ Gasoline, benzene, barbiturates
Anticholinergic Toxidrome	▪ Under-stimulation of cholinergic receptors characterized by dilated pupils (mydriasis), decreased sweating, elevated temperature, and mental status changes, including characteristic hallucinations. ▪ Atropine, scopolamine, chemical warfare agents such as BZ
Anticoagulant Toxidrome	▪ Alteration of blood coagulation resulting in abnormal bleeding ▪ Superwarfarins
Cholinergic Toxidrome	▪ Over-stimulation of cholinergic nerve receptors characterized by pinpoint pupils (miosis), seizing, wheezing, twitching, and excessive output from all secretory cells/organs ("leaking all over" – bronchial secretions, sweat, tears, saliva, vomiting, incontinence) ▪ Sarin, VX, phorate, aldicarb
Convulsant Toxidrome	▪ Central nervous system excitation leading to generalized convulsions ▪ Hydrazine, strychnine
Irritant/Corrosive Toxidrome	▪ Immediate effects range from minor irritation of exposed skin, mucous membranes, pulmonary, and gastrointestinal (GI) tract to coughing, wheezing, respiratory distress, and more severe GI symptoms that may progress rapidly to systemic toxicity ▪ Mustard agents, ammonia, chlorine, phosgene

Toxidrome*	Description and Example Chemicals
Knockdown/Metabolic Toxidrome	▪ Disrupted oxygen delivery to tissues leading to decreased consciousness, with cardiac signs and symptoms, including the possibility of cardiac arrest; interference with intracellular processes leading to multiple organ dysfunction, characterized by early gastrointestinal symptoms, with subsequent hair, nail, kidney, and/or neurological abnormalities ▪ Carbon monoxide, cyanide, arsenic, mercury, thallium
Opioid Toxidrome	▪ Opioid agonism leading to central nervous system and respiratory depression, characterized by pinpoint pupils (miosis), ▪ Heroin, oxycodone, fentanyl
Stress-Response/ Sympathomimetic Toxidrome	▪ Stress- or toxicant-induced central nervous system excitation leading to confusion, panic, and increased pulse, respiration, and blood pressure ▪ Caffeine, nicotine, amphetamines
	** A more detailed discussion of toxidromes is provided in Appendix B.*

Coordination Opportunity

Local poison control centers, statewide systems, and the National Poison Data System (NPDS) are invaluable sources of information for the purposes of chemical substance recognition and characterization. Coordinate with your local centers and state systems to understand how data are monitored and analyzed, including anomalies, unusual clustering of cases, etc.

What Will You Need to Know?

☐ What monitoring systems are used by industrial or other sector facilities and high- risk venues in your region?

- What do they do? How do they report?
- When will you be contacted?
- What information will you receive?

☐ Which human and veterinary health surveillance systems operate in your region?

- What do they do? How do they report?
- When will you be contacted?
- What information will you receive?

☐ How will you find out about food contamination events affecting your region?

- When will you be contacted?

- What information will you receive?

3.4. Response Initiation

A coordinated, well-executed response to a chemical release, including a suspected chemical attack, can greatly limit the spread of the chemical substance and the resulting casualties. Chemical recognition systems, therefore, should be developed to provide adequate coverage and shorten response time. Such systems should also be integrated into a holistic chemical recognition and response Concept of Operations to ensure their signals initiate an appropriate response. The response itself will be led by appropriate knowledgeable entities, often starting with local HazMat teams, and will involve additional agencies, such as the U.S. Chemical Safety and Hazard Investigation Board (CSB), as needed. For more information about federal roles of the USCG's National Response Center, EPA, and others in chemical incident response, see the Federal Preparedness, Response, and Recovery section of this document.

Action Item

Chemical incident recognition and response CONOPS and associated procedures should be rigorously trained and exercised periodically with facility/venue/system Operations Control Center staff.

Refer To

- *Federal Preparedness, Response, and Recovery* section in this document for more information on federal support mechanisms for response and recovery activities.
- U.S. Chemical Safety and Hazard Investigation Board

4. Incident Characterization: Substance and Site

While response and recovery activities must proceed in the absence of full information regarding a chemical release event, these activities will be safer and more efficient when critical chemical-specific information is known and a full evaluation of the release site has been performed. Information gained through timely incident characterization activities will provide situational awareness, inform decision-making, and facilitate efficient response by enabling the tailoring of response measures to address the specific chemical released, effectively use resources, and implement appropriate measures for the protection of worker and public safety. Further, application of this knowledge may help prevent further spread of contamination or additional exposures and may help reduce the overall economic impact of the incident.

- Response activities will be safer and more efficient when critical chemical-specific information is known.
- However, in the early stages of a chemical incident, decisions will need to be made without complete information.
- Incident characterization can help prevent the spread of contamination and further exposures and can reduce the overall impact of the event.

Incident characterization generally is more successful when a fully cooperative RP is engaged. In the best-case release scenario, the RP will immediately know the identity of the released substance and transmit that information, along with other relevant substance and site characteristics, to local authorities and/or the National Response Center (NRC). CERCLA and the Clean Water Act/Oil Pollution Act (CWA/OPA) require that oil discharges and releases of reportable quantities of listed hazardous substances be reported to the NRC. Similarly, incidents involving placarded materials, such as a crash of a tanker truck, will have information at the scene that could inform the response. However, plans also must be made for collecting the information needed to characterize incidents (substances and sites) in the absence of a RP, when the identity of the released chemical is not immediately known, or when the RP is not forthcoming with needed information. In such cases, full information about the chemical incident may not be immediately available and may be slow to gather as the incident unfolds, potentially taking hours (e.g., chemical identification), days (e.g., areas and/or population exposed), or longer (e.g., lethality, or long-term effects on infrastructure or the environment) to collect and analyze data from numerous sources. Thus, in the early stages of a chemical incident, decisions may need to be made without complete information. Importantly, incident characterization activities should be ongoing throughout response and recovery, with information continually refined and shared with responders and decision- makers.

4.1. Substance Identification and Characterization

While some response and recovery decisions can be made without knowing the released chemical's identity, others rely heavily on this information. Chemicals can differ widely regarding physical and chemical properties such as volatility, viscosity, and reactivity. Differences in these properties significantly affect response and recovery processes as unique properties influence impacts such as the penetration of the substance into building materials (some chemicals penetrate some materials more deeply than others) and the persistence of the substance in the environment (some chemicals persist in the environment for much longer time periods than others). The media into which the chemical is released can affect chemical transport, depending on its volatility and persistence. Knowing this information will help guide estimates of dispersal, sampling and analysis strategies, and decontamination techniques. Even properties such as the state of matter of the chemical can play a role in determining appropriate response and recovery activities; for example, gas releases generally have the potential to reach and expose a larger population. Finally, decontamination mechanisms and procedures for different substances vary and translate into vastly different approaches for remediation, which in turn may affect the time required to achieve recovery outcomes. (Available chemical information resources are provided in the Planning, Decision Support, and Modeling Resources for Chemical Incidents section as well as Appendix A.)

The real-time field detector technologies carried by HazMat teams (discussed below) can quickly identify many chemicals present in sampled media, on- site. However, the ability of these devices to detect hundreds of chemicals may not be enough to permit immediate identification of the released chemical given that there are tens of thousands of different chemicals in use across the U.S. Moreover, until recently, the agent used in the attack in Salisbury, UK, was not publicly discussed; in such cases, SLTT responders might not have immediate access to the capability to detect or identify the substance used. In addition to HazMat Team on-scene capabilities, EPA's CMAD can provide additional screening and sampling support for chemical events, including for CWA. CMAD equipment includes a Portable High-throughput Integrated Laboratory Identification System (PHILIS), a mobile laboratory with CWA and ICS identification capability. Further laboratory-based sample analysis can identify a wider spectrum of chemicals but is unlikely to provide substance identification as quickly as needed in an acute release scenario to prevent human health and/or environmental damage. Even when mobile laboratory capabilities are available (including PHILIS and HazMat team testing equipment), substance identification may be too slow to prevent serious consequences in some scenarios.

If on-site detectors fail, standard tests can classify the chemical substance(s) released into general categories, including auto-reactive, water-reactive, inorganic acid, organic acid, heavy metal, pesticide, cyanide, inorganic oxidizer, and organic oxidizer. Different chemical sampling and characterization approaches will need to be taken depending on the substance itself, whether the release medium is air, soil, ground water, surface water, food, or sediment. EPA provides guidance on available characterization and monitoring technologies via the CLU-IN network.

Refer To

Contaminated Site Clean-Up Information (CLU-IN) network provides information on chemical characterization and monitoring technologies.

Further analysis may be conducted by collaborating laboratories to more precisely identify the chemical substances associated with a specific release. Laboratory support for chemical identification testing may come through the Integrated Consortium of Laboratory Networks (ICLN) – a federal partnership between eight departments and agencies – to coordinate laboratory response capabilities during a crisis. The ICLN includes the following networks: DoD Laboratory Network, Environmental Response Laboratory Network, Food Emergency Response Network, Laboratory Response Network, National Animal Health Laboratory Network, National Plant Diagnostic Network, and the Veterinary Laboratory Investigation and Response Network. Again, when laboratory analysis is required for substance identification, the information is unlikely to be provided as quickly as needed in an acute release scenario to prevent human and/or environmental consequences.

Once the presence and concentrations of specific chemicals or classes of chemicals have been established, the hazards associated with these chemicals and their physical and chemical properties can be determined by referring to standard reference sources for data and guidelines. Understanding the chemical hazards faced can go far toward determining appropriate containment and cleanup methods. Available chemical information resources are provided in the Planning, Decision Support, and Modeling Resources for Chemical Incidents section as well as Appendix A.

Refer To

Planning, Decision Support, and Modeling Resources for Chemical Incidents section in this document for more information on chemical characterization resources.

4.2. HazMat Teams

In general, HazMat Teams have the following chemical detection capabilities and detection and sampling equipment and resources for use in substance identification and data collection (note that field devices are not as sensitive as and lack the broad chemical coverage of laboratory equipment):[28]

- **Type I Teams** – Designed to respond to, assess, and mitigate a large-scale, complex, and sustained- duration incident that may involve multiple hazards comprised of known and/or unknown hazardous materials, and especially including known or suspected weapons of mass destruction (WMD) materials and substances including CWAs.
    - Advanced testing instruments, such as gas chromatography and mass spectrometry devices for increased ability to detect and identify contaminants
    - Advanced real-time field instruments for perimeter air monitoring, such as surface acoustic wave (SAW) or nanotechnology devices; these are used to detect both liquid and gas CWAs and toxic industrial chemicals (TICs), organic and inorganic gases, explosives, illicit drugs, and in some instances, biological agents
    - Type II Team equipment
- **Type II Teams** – Designed to respond to, assess, and mitigate a large-scale, complex, and sustained-duration incident that may involve multiple hazards comprised of known and/or unknown hazardous materials.
    - Intermediate testing equipment, such as Fourier transform infrared spectroscopy (FTIR) or Raman spectroscopy devices, which can be used to detect and identify unknown solids, liquids, and gases including explosives, CWAs, TICs, and narcotics
    - Intermediate real-time field instruments, such as volatile organic compound (VOC) instruments with parts-per-billion sensitivity
    - Type III Team equipment
- **Type III Teams** – Designed to respond to, assess, and mitigate an incident for specific known hazardous materials.

- Basic testing instruments, such as chemical testing kits and testing strips
- Basic real-time field instruments, such as a multi-gas meter and Photo Ionization Detector (PID), enabling detection of common gases such as carbon monoxide (CO), carbon dioxide (CO_2), hydrogen sulfide (H_2S), sulfur dioxide (SO_2), methane (CH_4), and oxygen (O_2), and VOCs at parts-per-million sensitivity, respectively
- Printed and electronic reference resources
- Safety data sheets - SDSs contain information on chemical properties, human health and environmental risks, and handling, storage, and transportation precautions (see Appendix D)

Figure 35: HazMat team conducting sampling

4.3. Detection of Low-Volatility Agents (LVAs)

Speedy recognition of the use of low-volatility agents (LVAs) such as the nerve agents tabun, VX, and novichoks in an attack is critical due to their extreme toxicity. Yet without an incident “declaration,” it is particularly challenging.

Much of detection equipment is vapor-based and therefore not effective for the detection of low-volatility liquid nerve agents (and TIC/TIM substances). The low volatility of these agents also precludes the ability to detect from a safe distance, and, when compounded by the extremely high toxicity of these agents, means that some detectors cannot adequately detect the agents at safe airborne levels, and that only highly-trained personnel wearing appropriate PPE can safely perform testing. Unfortunately, monitoring, sampling, and analysis by US government teams with specialized training and equipment – such as the National Guard WMD-Civil Support Teams (WMD-CSTs) – may be the only way to determine if these types of nerve agents are present. Often, the specialized needs mean delays in agent identification; such delays could easily translate into significant additional exposures and secondary contamination hazards. For example, in the novichok incident described in the Prologue, identification of the agent used on the Skripals took three days; in the meantime, a first responder fell ill.[17]

What Will You Need to Know?

- ☐ What are the deployment times for the different HazMat Team types to your area?
- ☐ What real-time field detector technologies do they carry?
- ☐ Which of the local risk chemicals can they detect with real-time field sensors, and which would require laboratory analysis?
- ☐ What is the deployment time for CMAD to your area?
- ☐ When requesting HazMat and or CMAD team assistance, what information will you need to provide?
- ☐ Are there other real-time field detection options for local risk chemicals?
- What are the requirements and limitations of those options?
- How do you access local expertise to support use of those options?
- ☐ What laboratories provide analytical detection capabilities for your area?
- ☐ How do you contact those laboratories?
- What testing capabilities do they have?
- How do they report?
- How long will it take to receive test results?
- What information will you receive and when?
- ☐ What actions can be taken in the absence of specific laboratory test results?
- ☐ How do you contact local, state, and Federal agencies, such as the EPA, Local Emergency Planning Committees (LEPC), State Emergency Response Commission (SERC), etc., to initiate response coordination?

Action Item

Enable first responders to rapidly identify the chemical substance and determine its volatility and persistence by:

- Training responders on established hazardous materials guidance
- Training responders to think “outside the box” to identify non-traditional or unexpected substances
- Familiarizing planners and responders with available chemical information resources
- Upgrading sampling equipment

- Training responders and support staff on analyzing detector/sensor data
- Integrating access to hazardous materials databases into existing all-hazards planning and situational awareness systems

4.4. Site Assessment/Characterization/Determine the Extent of Contamination

Efforts to establish the identity of the released substance should be complemented by investigations to identify and characterize the source, size, and site of the release. Once the site of the chemical release is identified, a preliminary site assessment is performed to determine if further action is necessary. During the initial site assessment, information is gathered on site conditions, release parameters, potential additional releases, and potential exposure pathways to determine whether a cleanup may be needed and to identify areas of potential concern.

Hazardous Waste Operations and Emergency Response (HAZWOPER) standards require that a preliminary evaluation of the site's characteristics be performed prior to site entry by responders. This evaluation should be used to determine proper type and level of personal protective equipment (PPE) to be used during initial site entry. A more detailed evaluation should follow that aids in the selection of appropriate engineering controls and PPE for future site activities. These early evaluations should assess all conditions that are suspected to be immediately dangerous to life or health (IDLH) or that may otherwise cause serious harm to responders/response workers (e.g., confined space entry, potentially explosive or flammable situations, visible vapor clouds, etc.).[29]

Coordination Opportunity

Site investigations should combine information received from a variety of sources including:

- The Responsible Party
- Recognition capabilities (especially if the event was detected by an entity other than the RP)
- Environmental monitoring capabilities
- Health monitoring capabilities
- Meteorological information sources
- Geographic information sources
- Transportation information sources

Figure 36: Sample collection and field testing

As available, these evaluations should describe:

- Site size and location
- Site accessibility by air and roads
- Hazardous substances involved and their chemical and physical properties
- Detailed description of the activity that occurred at the site and duration of the activity
- The present status and capabilities of emergency response teams
- The potential for lingering hazards
- Site terrain and topography (from historical and current site maps, site photographs, aerial photographs, U.S. Geological Survey topographic quadrangle maps, land use maps, and land cover maps)
- Previous surveying (including soil, ground-penetrating radar, and magnetometer surveys), sampling, and monitoring data
- Pathways for hazardous substances dispersion, including geologic and hydrologic data
- Meteorological data (current weather and forecast, prevailing wind direction, precipitation levels, temperature profiles.
- The location of nearby population centers, and the population at risk
- Site perimeter ambient air monitoring for toxic substances, combustible and flammable gases or vapors, oxygen deficiency, specific materials (if known), and unusual odors
- Site perimeter collection and analysis of samples from soil, drinking water, ground water, site run-off, and surface water

Field measurements must follow a sampling plan that considers the specificity and sensitivity of the field equipment used for the substance released, as well as toxic concentration levels. Exposure data provide additional temporal and spatial information. Computer-generated contamination plume maps such as those generated by the Hazard Prediction & Assessment Capability (HPAC) can estimate airborne chemical concentration levels given relevant information such as outdoor temperature, humidity, and wind speed and direction. (Refer to the Planning, Decision Support, and Modeling Resources for Chemical Incidents section of this document for information on local use of HPAC.)

Assessment of lingering hazards at the release site is necessary for a full understanding of the risks posed by the chemical incident. Lingering hazards can be present after the initial toxic plume (in air or water) has passed. They can arise from entrapped or on- going, low-level leak sources or through a second major release. For example, after a railcar accident, some of the chemical may remain pooled at the accident site. Enclosed or low-lying areas can trap portions of a toxic vapor or liquid that can cause exposures at a later time. Lingering hazards can also arise from physical damage caused by the incident that may lead to fires, structural damage to buildings, and the release of other chemicals.

Together, the collected information will support situational awareness and an understanding of critical details regarding the release site, the extent of contamination, and the potential for further contamination spread. Particular attention should be paid to key pieces of information, such as the potential for the released substance to enter drinking water systems, and weather patterns that could drive the substance's further dispersal through air or water. The physicochemical characteristics of the substance can also play an important role in dispersal. The dispersal of gases, for example, will vary substantially with their density; this knowledge informs situational awareness and understanding of potential for contamination spread. The extent of contamination can be determined by combining field measurement, exposure, and modeling data (see below) to define contaminated versus non-contaminated areas, as well as the concentrations of chemical substances present in the contaminated areas. The resulting knowledge is crucial for both environmental and public health response and recovery as it informs specific actions needed across the affected area. If the information gathered points to an immediate threat to human, animal, or environmental health, contaminant removal or short-term cleanup actions may be conducted, and plans for long-term actions initiated.

A successful site investigation will identify the presence, movement, fate, and risks associated with environmental contamination at the site and will elucidate the chemical and physical properties of the site likely to influence contamination migration and cleanup. The investigation also will enable the tailoring of protective measures to the actual hazards to responders/workers, affected populations, and surrounding environment, and should lead to the implementation of safer and more efficient response and recovery efforts. In relation to other KPFs in this document, the data gathered via site characterization activities will help determine the up-to-date geographic extent of contamination and can inform decontamination and evacuation decisions, as well as resource allocation for survivor treatment (see KPF 4, Control the Spread of Contamination, and KPF 6, Augment Provision of Health and Medical Services to the Affected Population).

In the ever-changing environment of an unfolding chemical incident, all collected information, including the delineated contamination zones, must be validated and updated throughout the response and recovery. As time and ongoing remediation activities proceed, site conditions, including weather, will change. Data obtained during initial surveys can be used to develop a plan for the continued monitoring of ambient conditions throughout cleanup operations. Based on this plan, preliminary situational assessments should be iteratively refined as comprehensive data collection efforts continue. Keeping communication lines open will help ensure that updated incident assessment information, including any predictive outputs from modeling or other response tools, are quickly shared with response partners and decision-makers.

Coordination Opportunity

Develop relationships with federal, state, regional, and local agencies with a role in chemical incident response to identify partners that can help provide subject matter expertise to aid in substance identification and site assessment. Review past HazMat incidents in your jurisdiction and consider:

- Which relationships/partners were key to a successful response?
- Which relationships needed strengthening?

4.5. Modeling the Release (if applicable)

In addition to directly characterizing the extent and level of contamination at the release site, assessments typically define the area in which people, animals, and the environment may be affected by a chemical release, and help estimate the population at risk – that is, the number of people within a region where adverse health effects are possible. These estimates are often generated by modeling tools such as those listed in the Planning, Decision Support, and Modeling Resources for Chemical Incidents section of this document. Tools used each have strengths and weaknesses that are useful to keep in mind when planning response and recovery activities.

Refer To

Planning, Decision Support, and Modeling Resources for Chemical Incidents section in this document for more information on chemical characterization resources.

Modeling tools can be useful in estimating contamination plumes. However, airborne toxic clouds may meander due to changes in wind direction as they move. This characteristic simultaneously reduces the extent of the direct downwind hazard area while widening the potential hazard area. In some instances, modeling assessments based on current local meteorological conditions can account for uncertainty in the wind direction and estimate the resulting larger area that may be at risk. Modeling can also provide a picture of the downstream movement of chemicals released into a body of water. However, modeling tool outputs are likely to overestimate the extent of the hazard area because they don't completely account for losses of the chemical in a real- world environment. These losses may be due to reaction with environmental surfaces such as buildings, trees, the ground, water, or a riverbed.

Moreover, buildings can protect their occupants from exposure via the open air, depending upon the speed of the plume, the volatility of the substance, the ability to close building ventilation systems, the integrity of the building envelope, the time of year, location of air intakes, etc. However, standard modeling assessments often do not account for this protection. The fact that more than 75% of people are indoors at any given moment in a typical day has the potential to substantially reduce exposure, especially in urban settings.

Buildings channel the toxic cloud along open streets in urban settings, resulting in hazardous conditions that extend much farther than predicted by typical models, which do not include specific buildings as part of downwind hazard calculations. In addition, congested spaces within the urban environment slow the toxic cloud's passage and cause the airborne material to linger. When lingering effects are not considered during modeling, the toxic cloud may be predicted to leave the area faster than is the actual case.

A major source of uncertainty when using modeling in the immediate aftermath of a disaster is knowing how much material was released. Response modeling may assume the entire available volume has been released – potentially overestimating the amount of toxic material released and the overall areas impacted. Once again, this assumption will lead to an overestimate of the possible area affected by the hazard, which is probably the most prudent assumption to use until data can be gathered to demonstrate that other areas are truly safe. For all these reasons, sharing of new data regarding the incident as it becomes available is critical to ensuring modeling estimates are refined and updated, and are providing the best possible data to support decision-making.

What Will You Need to Know?

- ☐ What planning, decision support, and modeling resources are available to you?
- ☐ Which are best suited to the scenarios that are most likely in your jurisdiction?
- ☐ Which tools are already in use in your jurisdiction?
- ☐ Which tools are likely to be used following an incident?

Coordination Opportunity

Modeling resource centers such as IMAAC and NARAC often employ an array of tools when responding to information/data requests. For example, IMAAC's modeling suite includes CAMEO, HYSPLIT, HPAC, SHARC, and HAZUS-MH. Reachback modeling support from the Defense Threat Reduction Agency (DTRA) is also a key resource for SLTT responders. Thus, a single point of contact can be leveraged for access to multiple models/resources. For more information, visit IMAAC at https://www.fema.gov/imaac, and NARAC at https://narac.llnl.gov/, and DTRA at reachback@cnttr.dtra.mil.

Action Item

Establish protocols to determine the extent of contamination and to monitor and control contamination by:

- Developing and training on standardized methods for taking and analyzing field measurements, exposure data, and modeling outputs
- Developing field sampling plans that consider chemical specificity, field equipment sensitivity, and exposure standards
- Developing protocols to rapidly gain access to additional workers and equipment in an incident
- Familiarize planners and responders with available tools and how to contact modeling centers for assistance

4.6. Substance Identification in Food Contamination Events

In food contamination events, identification of both the contaminated food product and the contaminant itself play critical roles in reducing the incident's public health impact. Speedy and accurate symptom recognition is critical to identify contaminated products and guide the delivery of appropriate medical countermeasures. These countermeasures can be deployed – and be lifesaving – based on recognition of a patient's toxidrome, without necessarily identifying the toxic contaminant. However, the most potent countermeasures are often specific to an agent or a class of agents.

The ability to successfully warn the public to avoid exposure to contaminated foods and/or seek medical assistance depends upon identifying the exposure route – that is, the contaminated food product. The exposure route can be identified first from a combination of patient diagnoses and epidemiological investigations, and then confirmed with laboratory investigations of the potentially contaminated food items. For cases in which adverse health effects occur soon after ingestion, the association of symptoms with a particular food item may be readily apparent and even reported in the media. Contamination of products with short shelf-life, made in small batches, or consumed locally is easier to recognize (and thus identify) because affected individuals seek care at the same time and place. For example, the contaminated chicken tenders described in the Prologue were readily attributed as the cause of illness in schoolchildren, as symptom onset was immediate and experienced by dozens of individuals at a single site.[9] For cases in which adverse health effects occur well after ingestion (hours later), and for foods with longer shelf-lives, made in larger batches, and consumed regionally or nationally, the association of illness with a particular food item may be more difficult to uncover, and will rely more heavily on the work of investigators. Thus, details surrounding the exposure route can provide some insight into the magnitude of avoidable exposures.

Once the contaminated food product has been identified, the toxic material can be identified through laboratory investigations using patient samples and contaminated food items. Knowing the identity of the toxic material consumed can greatly improve medical care, patient outcomes, and incident management. In some cases, such as cyanide or heavy metal poisoning, immediate administration of medical countermeasures (MCMs) is critical. Although the need for laboratory analyses will generally delay substance identification in food contamination events, response activities that protect public health can proceed as the offending food product can be recalled well before the contaminant itself is known.

4.7. Intentional Acts

Intentional acts may include airborne releases of a chemical, an attack on chemical infrastructure, or an attack on chemicals in transit. Alternatively, intentional acts may target food, livestock, or crops. The chemicals that may be selected for intentional use can vary from military grade chemical warfare agents to various improvised chemical agents, toxic industrial chemicals, or pharmaceuticals.

The recognition and characterization of intentional events will differ from that for accidents in several ways. Firstly, there will likely be no RP to declare that an incident has occurred. Therefore, unless the attack happens to occur at a venue with exactly the right real-time field detection equipment, the event will depend upon recognition of and reporting on the symptoms caused in affected individuals. Furthermore, the identity of the released substance will not be immediately known. Additionally, the amount of substance released, the location of the release, and the method of dispersal likely will be unknown at the outset of the attack. Special attention will need to be paid to public communications strategies, as the public will likely be more distressed by an incident with intent to harm. To reassure the public, protect the safety of responders, and take the extreme lack of information into consideration, decision-making and the initiation of response activities should be approached cautiously and continually reviewed. Following an attack, the unknowns can pile up quickly, and access to accurate information will lag significantly.

While the Federal Bureau of Investigation (FBI) leads all criminal investigations of suspected chemical terrorism, the unique nature of chemical incidents mean that criminal investigations will likely occur concurrently with those led by other groups, such as public and environmental health investigations. In recent years, the FBI and CDC have introduced the concept of joint criminal and epidemiological investigations in which law enforcement and public health practitioners share information and draw on the unique expertise of both fields to maximize the effectiveness of characterization and response efforts.[30] This coordination extends to food contamination events; here, joint criminal and epidemiological investigations by law enforcement and public, animal, and/or plant health authorities should be conducted to determine the event's cause. Similarly, FBI coordinates with EPA in joint investigations that involve oil or chemical facilities,[31] as well as with other agencies with the appropriate jurisdiction and expertise. An effective multi-agency joint effort increases the likelihood of successfully attributing/ resolving threats (and thus also protecting the involved sector in the future) and ensures that rapid response and recovery operations do not interfere with or impede law enforcement operations or vice versa.

Coordination Opportunity

Consider state, regional, and local plans for incident recognition, threat characterization, and coordinated FBI/public/environmental health criminal investigations and establish coordinated plans among public health, emergency management, and law enforcement stakeholders.

Refer To

Terrorism Incident Law Enforcement and Investigation Annex to the *National Response Plan*

KPF 3 Communicate with External Partners and the Public

Establishing and maintaining communications during a chemical incident are important for two main reasons. First, communications enable coordinated efforts between and among response and recovery personnel and across multiple agencies, jurisdictions, and levels of authority. Second, communications convey important government messaging to inform the public on key aspects of the incident, what they can do to protect themselves, and what they can expect in terms of response and recovery activities in the community. During a chemical incident, communications are essential for overcoming the lack of awareness and common misperceptions about chemical uses, risks, and behaviors; communications should promote truths and provide actionable guidance. Overall, well-planned and well-exercised communications systems and strategies are critical to achieving response and recovery goals.

1. Recognize the Importance of Communications

Clear, coordinated, and reliable communications are essential to the effectiveness of any disaster response. There are, however, certain aspects of chemical incidents and public and responder reactions to them that make chemical incident responses especially vulnerable to communications failures, with the potential for dire consequences for human and environmental health and safety. In particular, chemical incidents often occur with little or no warning, and minutes can matter for the preservation or protection of human health and the environment. Communications delays, coupled with the public's and responders' misperceptions or gaps in knowledge regarding the uses, risks, and behaviors of chemicals, can cause these groups to act in ways that unknowingly put the health and safety of themselves or others in danger.

During a chemical incident, failures in communications processes and systems that hinder coordination between responding partners can result in more individuals being exposed and prevent first responder and public health system components from functioning as a team. Past chemical incidents have revealed several critical areas that emergency communications planners must consider. Firstly, the capacities of communications technologies are likely to be strained to the breaking point by extreme levels of use during a large-scale chemical incident. Secondly, it is essential that first responders and first receivers are privy to timely, accurate information so that they can provide appropriate care for survivors while keeping themselves safe. Further, robust, real-time, multi-directional communications capabilities connecting first responders with hospitals, the public health department, environmental safety officials, and laboratories are needed. Finally, forming relationships ahead of incidents with local experts that can be called upon to quickly assist in a chemical incident response will benefit risk mitigation efforts. In chemical emergencies, the immediate availability of the right expertise—from toxicologists, warfare agent specialists, poison control centers, chemical facilities, research centers, etc.—can be key to avoiding delays in the identification of the toxic substance involved and the timely transmission of essential lifesaving information throughout the emergency response system. The consequences of these types of communications failures during a chemical incident were highlighted in the aftermath of Aum Shinrikyo's 1995 attack in the Tokyo subway with the chemical warfare agent sarin,[22] described below. The considerations outlined in this KPF provide strategies to avoid these and other communications failures in chemical incidents.

Achieving success in chemical incident response and recovery often requires cooperation and coordination of a host of governmental and non-governmental (NGO) departments and agencies and with private organizations. Robust communications processes and integrated operations systems enable the coordination of response and recovery efforts between and among federal, state, local, tribal, and territorial (FSLTT) departments and agencies as well as private and non-governmental organizations. Communications stakeholders include personnel in public health and healthcare, emergency medical services, emergency management, law enforcement, civic leaders, and environmental safety, among various others depending upon the specifics of the incident scenario. This KPF describes the importance of developing, coordinating, and communicating chemical incident-specific messages for the affected population and the community at large, as well as the coordination of communication between the multiple potentially involved response and recovery agencies. Advance planning can facilitate timely, consistent messaging across all levels of government, the private sector, and the general public throughout response and recovery processes, thereby building public trust and leading to better community-wide response and recovery outcomes.

Figure 37: Coordination and integrated operations among a wide range of partners is critical to understanding risks and to identifying appropriate response and recovery actions

2. Recognize the Importance of Partner Communications: Lessons from Tokyo[22,32]

The aftermath of Aum Shinrikyo's 1995 attack in the Tokyo subway with the chemical warfare agent sarin demonstrated the consequences of inadequate communication with the public and response partners during a large-scale chemical incident. First, civilians, transit authorities, and first-responders that individually became aware of a critical problem were slow to report it or to coordinate action. For example, although the subway train control center was notified of a critical issue, trains were allowed to continue on their scheduled routes, resulting in the contamination of multiple train lines, fifteen stations, and hundreds of people. In fact, it was roughly forty minutes into the response before orders went out from the police requiring that rescuers entering the subway system wear gas masks.

Essential components of the medical system were crippled by inadequate communications systems. As the event escalated, the sheer number of rescue vehicles activated clogged regular communications channels. Ambulance crews were unable to get through to the dispatch center to determine which hospitals could receive patients; some even stopped at pay telephones to try to secure instructions directly from hospitals.

Figure 38: Affected persons and response workers following the 1995 Aum Shinrikyo sarin attack

Further, essential incident information was not delivered to Tokyo hospitals. Doctors at one hospital located near the affected subway stations reported receiving no information from city fire or police departments about what was occurring—they heard only that there might have been an explosion in the subway system—and were forced to rely upon television news reports for event details. Due to the information vacuum, the decision to expand emergency medical operations to include the entire staff was delayed, and it was roughly two and a half hours after the first affected person reached their doorstep that the hospital's staff finally learned—again from television broadcasts, not through official channels—that the toxic substance involved was sarin. Only then did hospital staff began to administer the appropriate nerve agent antidote treatment to injured patients.

Aum Shinrikyo's attack also made clear how communications between experts and responding partners can be critical for the dissemination of potentially lifesaving information during a chemical incident. In particular, a physician familiar with treating patients exposed to sarin called hospitals during the attack in Tokyo to alert them that the symptoms he was seeing on television mirrored those he had seen during a previous attack. He also assisted medical staff near subway sites in making the diagnosis of sarin exposure. Given the lack of information flow to hospitals, his expertise was likely lifesaving. From the attack, Tokyo officials and physicians learned the importance of pre-planning and the need to pre-identify and link the range of experts that responses to certain situations might demand.

In Tokyo, crisis response communications of civil and government organizations were not effectively coordinated, and in some cases experienced technological failures. In addition, the absence of immediate and clear information delivery to the public led to medical facilities being overwhelmed with patients who were at little to no risk of experiencing illness. Overall, public safety and services suffered.

3. Communications for a Coordinated Response

3.1. Communicate to Coordinate with Response Partners

For any disaster, incidents are largely managed or executed at the closest possible geographical, organizational, and jurisdictional levels.[33] Accordingly, the optimal response to a chemical incident depends upon the scope and scale of the event and follows the model of being locally executed and managed unless the scope and scale of the incident requires additional assistance. State, tribal, and territorial (STT) assistance can be requested, along with federal support, if needed and available. Private sector and NGO engagement may be available in the context of many incident types. For the majority of chemical incidents, incident management will entail, at a minimum, communications between local officials and the Responsible Party (RP), if a RP is pertinent to the incident type. As incidents become larger and the responses more complex, the need for support from FSLTT partner agencies is more likely. Thus, for smaller-scale incidents, unified coordination may be as simple as meetings between departments and agencies; during recovery from small-scale incidents, these might be weekly meetings. However, in the context of complex, larger-scale incident response and recovery, more formalized and frequent partner communications will be required to maintain coordination between individual organizations and agencies, each with their various individual authorities, roles and responsibilities, and scopes of work.

Coordination of communication systems and the communications themselves between FSLTT partner agencies and private sector responsible parties is essential for maintaining situational awareness and keeping track of the ever-changing status of critical services, resources, and infrastructure during the response to and recovery from a chemical incident. Ultimately, the coordination of decision-making, resource allocation, and other specific activities among these same entities is critical for a successful, efficient, and cost-effective response and recovery. Interagency communications and information sharing will enable multi-entity teams to coordinate and maintain good relationships within the changing response and recovery environment, particularly as timelines and authorities shift.

3.2. Locally Executed Response

In addition to the Responsible Party, local partners such as public works, law enforcement, emergency medical services, hospitals, and fire departments know the community's needs, capabilities, and resources, and are best positioned to effectively and immediately mitigate the consequences of an incident. Coordination with these entities as well as planning committees, healthcare coalitions, Community Emergency Response Teams (CERTs), and chapters of national-level associations may occur on- scene at incident command posts (ICP) and at local emergency operations centers (EOCs). Local incident management may also involve Multiagency Coordination Groups (MAC Groups) composed of senior officials who are authorized to commit agency resources in support of response activities, thus supporting resource prioritization and allocation and enabling decision-making by elected officials and those managing the incident.[33]

Coordination Opportunity

Ensure timely, official communications and the sharing of situational awareness with critical supporting (i.e., poison control) and receiving partner agencies (i.e., hospitals) at the local level early in the response. As demonstrated by the sarin attack in Tokyo and the accidental poisoning of school children by contaminated chicken discussed in the Prologue,[9,22] doing so is essential because it allows partners the opportunity to begin to prepare themselves for the response, including taking self-protective measures, activating emergency protocols, and readying appropriate treatments, and eliminates confusion caused by social media and early reports from outside unknown sources.

Large-scale chemical incidents may require support across jurisdictional lines. As a part of all-hazards planning for other large-scale emergencies like floods and wildfires, many communities may already have formal mutual aid agreements (e.g., MOUs, MOAs, LUAs) with neighboring jurisdictions to provide aid in support of all-hazards response and recovery. Ensuring that these agreements include specialized chemical incident support should be a priority consideration. Further, these local plans should not be limited to agreements for the sharing of personnel, supplies, and equipment across nearby jurisdictions (discussed in KPF 1, "Prime the Pump" Pre-Event Planning), but should also incorporate agreements for the sharing of communications plans. This is especially true if local chemical risks point to the possibility of responders, including public information officers (PIOs) and communications staff, being located in an area in which they could receive dangerous chemical exposures, and, therefore, be advised to evacuate. With appropriate contingency planning for communications, a neighboring jurisdiction (nearby city or county) could step in to disseminate immediate protective action messages to people in the affected area. Additionally, to maximize response effectiveness, communications interoperability across jurisdictions will need to be ensured pre-event. Entering into these discussions before an incident occurs allows local officials to advocate for particular communication emphases in formal plans and agreements and establish the importance of rapid communication for saving lives and minimizing other adverse health and safety effects early in the planning process.

The coordination of decision-making and response activities is critical for a successful, efficient, and cost-effective response and recovery.

3.3. State, Tribal, and Territorial Managed Response

State, tribal, and territorial EOCs are activated as necessary to support local EOCs and to help ensure that responders have the resources they need to conduct response activities.[33] As described in the Prologue, state support can be critical for ensuring populations affected by an incident receive the immediate help and supplies they need, including, for example, clean water when the local water source has been contaminated.[4] State support is delivered through integration of state- and local-level coordinating structures. Coordinating structures at the state level vary, depending on factors such as geography, population, industry, and the capabilities of the local jurisdictions, and are designed to leverage the capabilities and resources of partners from across the state/tribal land/territory. In some instances, such as the pesticide poisoning of field workers described in the Prologue,[6,7] chemical incidents may even not be identified without the cooperation of investigating state agencies.

Regarding communications with the public, an intentional or otherwise large- scale incident will attract regional, national, and multi-national interest. Local public communications teams likely will be overwhelmed by inquiries and will look to public affairs staff from neighboring jurisdictions and state (and federal) agency communications offices for help meeting the demand. As the response team grows and more organizations are added to the incident command structure, their public affairs staff will be available to help answer questions from the press and the public as well.

3.4. Federally Supported Response

Responses to incidents involving oil, hazardous substances, pollutants and contaminants, and chemicals fall under the authority of the National Contingency Plan (NCP).[1,34,35,36] The Federal Government may activate the NCP when the response needs of such an incident exceed (or are anticipated to exceed) SLTT resources, or when the incident is managed by federal departments or agencies acting under their own authority. Under the NCP, the National Response System (NRS) and the National Response Team (NRT) provide interagency planning, policy, and coordination, technical advice, and resources and equipment. The NRT also sets up a Joint Information Center (JIC) for public communications staff, discussed further below. The NRT includes representatives from 16 federal departments and agencies and is chaired by the EPA, with the USCG as vice-chair.[37,38]

For incidents that fall under the NCP, the USCG (for coastal releases) or EPA (for inland releases) will provide a Federal On-Scene Coordinator (OSC) who directs and manages response activities. (Refer to the Federal Preparedness, Response, and Recovery section of this document for additional discussion of federal support for chemical incidents.) In the event of a Spill of National Significance (SONS), multiple locations and command posts may be established across a large geographic area; when there is more than one agency with incident jurisdiction, or when incidents cross political jurisdictions, a Unified Command (UC) is established. A UC for a chemical incident response typically consists of the federal OSC, state OSC, and local emergency response Incident Commanders (ICs), and the Responsible Party (RP). UC members work together to develop objectives and strategies, share information, maximize the use of resources, and enhance response efficiency, although the federal OSC maintains ultimate decision-making authority for the NCP response and the polluter (i.e., RP) pays.[37,39]

The NCP is aligned with the National Response Framework (NRF) and National Incident Management System (NIMS). In parallel to the NCP, the NRF provides structures and mechanisms for responding to threats and hazards ranging from accidents to technological hazards, natural disasters, and human-caused incidents. The Federal Government and many state governments organize their response resources and capabilities under the NRF Emergency Support Function (ESF) construct. Depending on the nature and size of a chemical incident, ESF annexes to the NRF may be activated in addition to the NCP, namely, ESF #10, the Oil and Hazardous Materials Response Annex, and/or ESF #15, the External Affairs Annex, discussed further below. Thus, as more support is needed and the response builds out, command and coordinating structures are supported by an expanding cadre of communications and public affairs specialists.

Refer To

Federal Preparedness, Response, and Recovery section of this document for additional discussion of federal support for chemical incidents and incident response coordination under the National Contingency Plan.

3.5. Leverage Partner Resources to Provide Informed Public Guidance

During a chemical incident, decisions on the need for protective actions must be made quickly, whether that action might be an area evacuation or a Do Not Use directive for water (see KPF 4, Control the Spread of Contamination for further discussion of protective actions). When uncertainties abound yet actions must be taken quickly to save lives and property, all available sources of information and expertise should be leveraged to support efficient decision-making. Many resources are available to help assess the situation, make predictions on chemical behavior, and estimate potential consequences. A host of planning, decision support/response, and modeling/ simulation tools are described in the Planning, Decision Support, and Modeling Resources for Chemical Incidents section of this document. For example, atmospheric dispersion modeling can be used to determine what areas, if any, should receive protective action guidance (e.g., evacuate or shelter-in-place) following the release of a volatile chemical. Federal modeling centers such as the Interagency Modeling and Atmospheric Assessment Center (IMAAC) and National Atmospheric Release Advisory Center (NARAC) can provide access to and assistance with multiple modeling resources for a range of chemicals and release scenarios. The use of these resources in determining the appropriate course of action should be made transparent by decision-makers; otherwise, public trust in official guidance will be degraded as unreliable assessments and unofficial alternative guidance are promoted by media "experts." Note that due to the nature of chemical incidents, in many cases, a protective action decision cannot wait the hours needed to perform modeling analyses. However, post- incident modeling can be a useful tool for characterizing situations in which the chemical released is persistent, or when the release is ongoing.

Refer To

- *Planning, Decision Support, and Modeling Resources for Chemical Incidents* section of this document for more information on decision support/response, and modeling/simulation tools.
- *2020 Emergency Response Guidebook*

Additional sources of information for assistance in evaluating a situation and for decision-making include:

- The Department of Transportation (DoT)'s Emergency Response Guidebook (ERG), which provides immediate protective action guidance, down-wind field predictions, and public health related information for chemical responses.
- CHEMTREC® which provides chemical-specific and general assistance during emergencies, around-the-clock access to hazardous material safety information, and, if needed, teams of experts to assist with the response and recovery.
- In addition to joint drills with local first responders, many sector partners also participate and support The Transportation Community Awareness and Emergency Response (TRANSCAER℠), which offers reference materials for HazMat emergencies as well as training and exercises to help first responders and communities prepare for and respond to HazMat emergencies.

Chemical incident-specific technical and emergency management expertise is also available through reach-back to federal agencies. For example, DHS's Chemical Security Analysis Center (CSAC) offers "CSAC Technical Assistance" to FSLTT and first-responder agencies, including around-the- clock subject matter expert analyses regarding the threat or hazard posed by a specific chemical. Consultation with knowledgeable SMEs is recommended whenever possible to contextualize situational assessments and tool outputs and to confirm interpretations. An example of a chemical expert that can seamlessly integrate into emergency management operations is a Chemical Operations Support Specialist (COSS), a chemical professional trained and certified in a program developed by FEMA's CBRN Office. COSS are chemical safety professionals who are familiar with the Incident Command System and therefore can provide expert chemical information to responders and emergency managers; know what federal resources can be brought in to assist the response; and can assist communications staff in simplifying and clarifying information. (COSS are further discussed below.)

Figure 39: Resources available for response support include IMAAC, NARAC, and COSS

3.6. Private Sector Engagement

The public sector alone cannot provide all the resources needed to respond to incidents; the government and private sector must collaborate and partner during incident response. Coordinating structures for the private sector include business emergency operations centers (BEOC), industry trade groups, information sharing and analysis centers, and entities such as healthcare coalitions that support collaboration and communications across the private sector. Such organizations can coordinate with and support NGOs and serve as a conduit to government coordinating structures.[33]

Coordination Opportunity

Develop pathways for interagency coordination/integration between and among (1) governmental agencies, key businesses, and health care facilities; including key supporting (i.e., poison control) and receiving partner agencies (i.e., hospitals); (2) public health, emergency management, and law enforcement stakeholders; and (3) SLTT, regional, federal, and international agencies and organizations. FEMA provides operational assistance for coordinating the federal interagency as appropriate.

Action Item

- Develop chemical incident-specific partner messaging and communication strategies
- Develop protocols and procedures for ensuring timely communication and situational awareness to supporting (i.e., poison control) and receiving agencies (i.e., hospitals) early in the response
- Survey cities and counties in your state to better understand what communications MOUs are already in place
- Discuss the need for cross-jurisdictional communications support and communications interoperability during response to a chemical incident

- Confirm data-sharing capabilities with other jurisdictions in your area
- Work with other jurisdictions to familiarize each other with chemical incident response plans
- With neighboring jurisdictions, review existing plans for communications specific to a chemical or other large-scale catastrophic incident
- Exercise communications plans with nearby jurisdictions to establish them as trusted agents in an emergency and ensure they know how best to reach people in your community

3.7. Coordinate with Response Partners to Communicate with the Public

During a chemical incident, there will be a time-sensitive demand for information. The media, public, and responders all require accurate and timely information, whether the incident is large or small, and whether caused by a natural disaster, accident, or intentional act. The public will immediately turn to the media and sources they consider trustworthy to find out more details.[40,41] Meanwhile, the attention of the media will also help drive the need for coordinated messaging. The needs of both can be filled by a Joint Information Center. Under the collaborative structure of the NCP and the NRF, communicators working across multiple responding organizations employ the NRT's JIC model to achieve the efficiency of information flow that is critical to effectively meeting these information needs.[34,37]

Under the NCP, the federal OSC will designate an Incident Command Post Public Information Officer (ICP PIO); this member of the Incident Command System (ICS) staff is responsible for gathering, developing, and disseminating information about the incident to the news media, affected public, and response personnel. The PIO will gather information, write news releases or other informational products, answer media questions and calls, and set up websites, town halls, or social media sites, etc., and will advise the federal OSC or UC on public information matters. During large-scale incidents, the PIO may appoint assistants to represent assisting agencies, jurisdictions, or other response partners. During the Deepwater Horizon response, for example, more than 300 interagency Public Affairs Officers (PAOs) supported the response.[42]

The PIO will establish and maintain a JIC for assistance in communication tasks. The JIC is the central physical or virtual location where incident information is organized, integrated, and coordinated to ensure timely, accurate, accessible, and consistent messaging across multiple jurisdictions and/or disciplines. Because they are constantly interacting with the IC/UC and other Command staff, the PIO can keep the JIC abreast of critical decisions, enabling JIC staff to keep messaging current in the face of changing priorities.

The JIC structure is flexible and is designed to meet the needs of incidents on any scale, ranging from a small single-agency, single-hazard response to a large multiple-agency, all-hazards response. The organizational chart below illustrates general staffing and management, activities, and divisions within the JIC. The PIO has responsibilities dictated by the NIMS ICS and spends most of the time working on strategic goals with the IC/UC and other Command staff. The JIC Manager works with the PIO on strategic plans and directs the Assistant PIOs (APIOs). The APIOs are top-level "specialists" that support "boots on the ground" staff that implement tactical PIO operations in several key areas: Information Gathering (fact gathering, media monitoring, and rumor control), Information Products (writing news releases, photography/videography, and website management), Media Relations (answering media calls, coordinating interviews, and speaker support), and Community Relations (community relations, community support, and social media, for incidents with major community relations issues). A JIC may also have representation in the field.

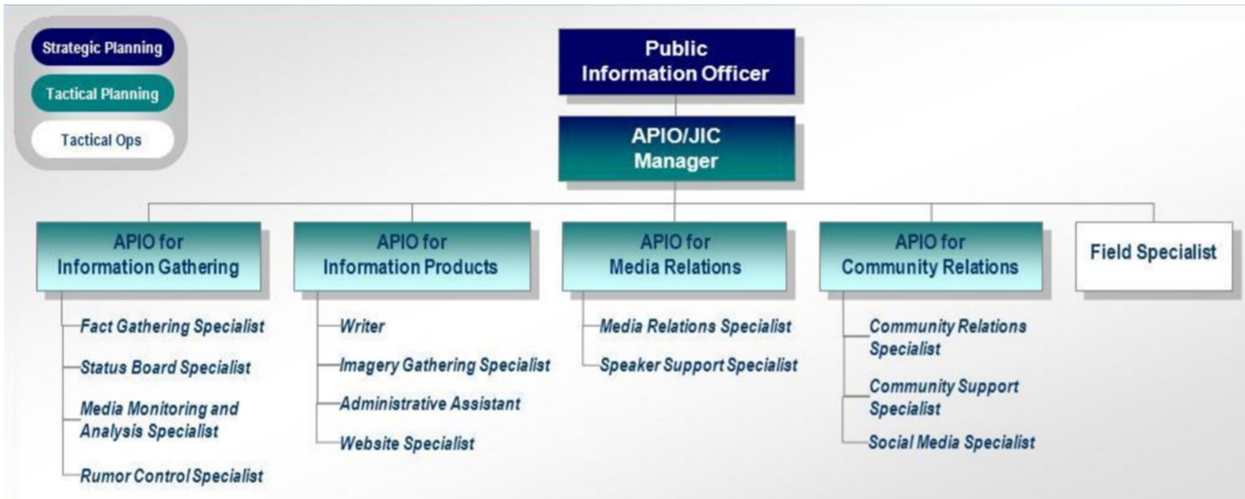


Figure 40: The National Response Team Joint Information Center model is an all-hazards model that is compatible with the National Incident Management System.[34] Note that for chemical incidents, HAZWOPER certification or the wearing of PPE may be required to photograph or film near the hazard site.

3.8. Co-Activation of a Joint Information Center and Emergency Support Functions (ESFs)[34,35,37]

In parallel with the NCP, the NRF outlines the federal government's guiding principles for preparing for and providing a unified national response to disasters and emergencies. Within the NRF, specific mission support areas, the Emergency Support Functions (ESFs), group federal resources and capabilities into functional areas that serve as the primary mechanisms for providing assistance at the operational level.

In the event of a Stafford Act declaration for a chemical incident, ESF #10, the Oil and Hazardous Materials Response Annex of the NRF, may be activated to provide a coordinated federal response that is generally carried out in accordance with the NCP. The NRT has developed two general, pre-agreed upon ESF #10-related press release templates that can be used by member agencies to disseminate information to the media and the public. In some cases, ESFs may also be activated for non-Stafford Act incidents at the Secretary of Homeland Security's discretion, and/or to support NCP responses that require an extraordinary level of federal resources. ESF #15 is activated at the national level to support response communications when the Department of Homeland Security

(DHS) determines an incident is complex enough to require a coordinated interagency communications effort; states and local jurisdictions also typically maintain ESF #15 capabilities that can be called upon. For example, during Deepwater Horizon, components of the ESF #15, the External Affairs Annex of the NRF, were used to support the response.

The NRT JIC and ESF #15 play connected yet distinct roles in communications. Under the ESF #15 construct (see below), External Affairs Officers (EAOs) are assigned to functional areas; these functional areas are organized differently than the NRT JIC functional areas. ESF #15 is not intended to direct response communication efforts, but instead to support them by providing additional coordination mechanisms and additional resources to support a national communications effort. ESF #15's focus is strategic with some operational elements, while NRT JICs are tactical, with some strategic communication functions focused on command-post level operations. When ESF #15 is activated, the NRT JIC and the ICP PIO retain the information release authority delegated to them by their respective federal OSC/Incident Commander. A regular line of communication should be established from the ICP PIOs via the NRT JIC to the ESF #15 Deputy EAO or EAO to exchange information and requests for support based on the needs of the response.

Refer To

FEMA is an NRT member agency that has developed several guidance documents and training courses for PIOs that provide samples of several different JIC organizational structures:

- NIMS IS-702 (Public Information Systems) training
- *National Incident Management Systems Basic Guidance for Public Information Officers* (December 2020)
- NIMS IS-250 (Emergency Support Function #15) training
- Although the job titles and responsibilities may vary between the various JIC organizational structures, they are designed to perform the same mission: to keep the public informed during a crisis/event.
- The *Oil and Chemical Incident Annex* (OCIA) to the *Federal Interagency Operational Plan*, provides additional information on an NCP response with ESF support.
- *ESF #10—Oil and Hazardous Materials Response Annex*
- *ESF #15— External Affairs Annex*

3.9. Emergency Support Function #15 – External Affairs Annex[43]

ESF #15 integrates the Public Affairs, Congressional Affairs, and Intergovernmental Affairs (local, state, tribal, territorial, and insular areas) components of federal departments and agencies with the private sector as External Affairs. ESF #15 affects all federal departments and agencies that may require incident communications and external affairs support or whose external affairs assets may be employed during incidents requiring a coordinated federal response.

ESF #15 coordinates the development and release of accurate, timely, and accessible information and instructions to affected audiences, including the government, media, NGOs, the private sector, and the local populace (including children, those with disabilities, limited mobility, the homeless, individuals with limited English proficiency, etc.). This includes content related to:

- Federal assistance to the incident-affected area
- Federal departmental/agency response
- National preparations
- Protective measures
- Impact on non-affected areas

Figure 41: Upon ESF #15 activation at the federal level, External Affairs efforts are coordinated by the DHS Assistant Secretary for Public Affairs or the FEMA Director of External Affairs

When ESF #15 is activated at the federal level, External Affairs efforts are coordinated by the DHS Assistant Secretary for Public Affairs or the FEMA Director of External Affairs, and the DHS Public Affairs' National Joint Information Center (NJIC) serves as the federal incident communications coordination center. The DHS/FEMA External Affairs Ready Room is also activated as needed in incidents when DHS/FEMA is the lead federal agency for coordinating communications.

When the NRT JIC model and ESF #15 are both activated, the two align functions and communications efforts.

Coordination Opportunity

Plan for coordinated incident communications with a wide stakeholder membership. This group will (a) coordinate interagency messages, (b) develop and execute public information plans and strategies, (c) advise the On-Scene Coordinator concerning public affairs issues that could affect the response effort, and (d) monitor and control inaccurate information that could undermine public confidence in the incident response effort.

What Will You Need to Know?

- ☐ Who are the SLTT stakeholders in your region?
- ☐ What are the private and non-governmental organizations in your region?
- ☐ What are the coordination communications protocols for a chemical incident with SLTT stakeholders? Private and non-governmental organizations?
- ☐ Who are the On-Scene Coordinators (OSCs) from the EPA and the USCG in your region?
- ▪ What are the coordination communications protocols with the OSCs?
- ☐ How will you develop a full understanding of risks, identify appropriate response actions, and provide accurate public risk communications?
- ☐ For a Stafford Act event, how will you engage federal communications protocols?

4. Communications for an Informed Public

For any disaster, *effective* public communications are vital to the success of response and recovery operations. For a chemical incident, *effective* public communications involve the transmission of, via readily available channels, potentially lifesaving information to the population at risk of exposure in a manner that they can understand such that they will choose actions or behaviors that are protective of human and environmental health.[40,44] The responsibility of effectively communicating information relevant to local chemical risks falls to PIOs and public affairs specialists, community leaders, emergency managers, incident commanders, and first responders.

Public communications must synthesize complex human and environmental health information to promote public compliance with guidance. Public fear typically occurs with large-scale incidents.

Coordinated, accessible messaging and information that adheres to principles of risk communication, even in areas unaffected by the incident, are crucial.

For a chemical incident of substantial size, complexity, and/or consequence, the need for effective communications during response is heightened due to the potential for the population or the environment to become directly exposed to or contaminated by the substance or as a result of a secondary transfer from a contaminated individual or surface. Thus, for a chemical incident, immediate response outcomes are closely tied to:

- The speed with which crisis and emergency risk communications on protective actions are deployed to the population-at-risk and the population-at-large
- The accuracy and clarity of the information provided
- The speed with which (and extent to which) the public complies with guidance on measures for personal and environmental protection

Public compliance is heavily influenced by public perception. Therefore, in a chemical incident, public communications must synthesize complex information, present it clearly and confidently, and instill/maintain public trust to elicit the best possible compliance with protective, potentially lifesaving guidance. For example, during the immediate response to a chemical incident, effective communications between government officials and the public can minimize panic and increase public adherence to evacuation or other actions, and have the potential to reduce the extent of environmental damage and human and animal health injuries. (Evacuation and other potential protective actions are discussed in KPF 4, Control the Spread of Contamination.)

Success in achieving desirable response and recovery outcomes are reliant upon continuing communications that:

- Provide timely and continuing messaging to the public for warning, guidance, and information sharing
- Maintain public awareness of ongoing cleanup and remediation activities and ongoing human, animal, and environmental health risks
- Maintain empathetic and validating two-way communication between decision- makers and the public
- Coordinate messaging for the above through the interagency process as appropriate

Effective response and recovery communication will be fostered by comprehensive and flexible communication plans, strategies, and content, developed prior to an incident. Maintaining public trust and compliance with warnings and guidance will continue to be a key objective of communications activities during incident response and recovery. The following sections discuss considerations and guidance for message content and delivery, as well as communications strategies promoting successful response to and recovery from a chemical incident.

Keep in mind that public communications during chemical incident response will likely include timely, accurate and consistent incident information, including relevant animal and public health guidance. Due to the involvement of potentially toxic substances in the incident, they will likely be more complex than most emergency messages.

Coordination Opportunity

Enhance the crisis and emergency risk communication framework by conducting cross-disciplinary training on issuing protective action guidance, including the expansion of pre-scripted messaging targeted towards all community stakeholders (discussed below), including the private sector. Ensure all stakeholders, including governmental agencies, key businesses, and health care facilities, understand the importance of providing consistent, coordinated, accurate, accessible, timely, and understandable information to the public.

Refer To

CDC's Crisis Emergency Risk Communication manual for a comprehensive introduction to the principles and practical tools of crisis and emergency risk communication (CERC).

5. Provide Time-Critical Messaging

Chemical incidents involve situations where minutes can matter. In large-scale or intentional chemical incidents, timely, effective warnings can be lifesaving; they can prevent tens of thousands of individuals from being injured via chemical exposure and/or contamination. Critical protective action directives and safety instructions may need to be disseminated quickly, across all possible channels, to safeguard human and animal health. The ability to provide time-critical messages following an incident hinges on three critical factors:

- Advance preparation of messages
- Timely dissemination of those messages
- Use of duplicative outlets for message dissemination

Figure 42: The Emergency Broadcast System is one option for quick dissemination of messages

5.1. Advance Preparation of Messages

Timely communications describing chemical risks and protective actions will be necessary to help the public understand the actions they can and should take to protect themselves and their loved ones. Having pre-scripted and pre- approved messages immediately available when a chemical incident happens will help address the first of these critical factors. In the chaos of a chemical incident, the absence of pre-scripted and pre-approved messages is likely to delay public communications. Moreover, communications are likely to be inconsistent, increasing public confusion and degrading public trust. Therefore, the composition and approval of pre-scripted messages before an incident occurs should be part of preparedness and planning activities. Based on local chemical risks and existing emergency response plans, pre-scripted messages describing substance identity and health risks, and potentially even locations to avoid, can be developed.

To maximize public compliance with messages providing protective guidance, warning messages should meet style and content criteria designed to elicit the desired public response (see below), and ideally, should be optimized for each communication channel used. Briefly, people respond best to messages that use jargon-free, non-technical, plain language that is specific (i.e., precise and non-ambiguous), accurate (i.e., free from errors that create confusion), certain (i.e., authoritative and confident); and consistent. Following these criteria is especially important in a chemical incident since messages that are not understood will be ineffective at preventing or minimizing the risk of chemical exposures. Follow-on response messaging should keep to the same style criteria while focusing on a similar but broader range of content (see below).

People will want to know why a certain protective action is required before they will take that action. They will want to know information such as: the severity of the incident, their likelihood of being exposed to contaminants, what to do and where to go if they have been exposed or contaminated, what immediate medical life-saving actions they should take if they have been exposed or contaminated and are experiencing symptoms, the efficacy and costs or risks of recommended behaviors, and their ability to perform the recommended behaviors.[45] However, when minutes are critical for lifesaving, there is a delicate balance between giving simple, easy to understand instructions, and explaining why the public should follow them. Communications staff should be aware that terms and phrases commonly used in the emergency response field, like 'shelter-in-place,' may not be immediately understood by the public and may require additional definition. Providing even a brief explanation of the protective actions ordered can help increase public acceptance and compliance with the recommendations. Relating protective actions to other incidents that require them, like sheltering from tornadoes, can further increase people's understanding and compliance with safety instructions. Having simple and reasoned explanations for action directives and ready answers to anticipated questions will help avoid chemical exposures, increase public trust, and ultimately save lives. Visit the resources noted below for help with designing effective messages.

Keeping language simple and easy to understand will help ensure people take the right protective actions at the right times and in the right areas.

People will want to know why an action is protective before they will take that action.

The second component of the advance message preparation process is message pre-approval. Developing an approval chain before an emergency happens is essential for speedy delivery of messages to the affected area. Local plans or approval chains may already be in place as a result of all-hazards planning, although additional review and approval steps may be necessary based on the specifics of the situation at hand and whether or not a unified command is activated, a JIC is activated to coordinate messaging priorities, or multiple jurisdictions are working together in the response. Briefings, trainings, and exercises may be used to broach the need for developing these approval chains with decision- makers and underscore the need to get messages out quickly in the face of a chemical incident. Following pre-approval, a "bank" of prioritized responses to media outlets, requests for interviews and information, and public questions can be created that will help meet the overwhelming number of inquiries that will be received during an incident.

5.2. Response Communication Guidelines[41,46]

In terms of compositional style, warning messages should be:

- Specific – Minimize the time the public spends seeking information to confirm the risk.
- Consistent – Messages should not contain contradictory information, nor should the message from one communication channel contradict the message distributed through another channel.
- Certain – Describe what is known and unknown in certain terms. Do not guess or speculate.
- Clear – Use common words that can easily be understood and avoid technical terms or jargon. If protective instructions are precautionary, state so clearly. If the chance of the event occurring is less than 100%, convey the likelihood in simple terms.
- Accurate – Do not overstate or understate the facts or omit important information.
- Accessible – Craft messages with consideration for people with disabilities (e.g., vision- or hearing- impaired populations) and for non-English speaking residents.

In terms of content, warning messages should include the following:

- Specific hazard – What is the chemical hazard? What are the potential risks for the community?
- Location – Where will the effects occur? Is the location described so those without local knowledge can understand their risk?
- Timeframe – When will it arrive at various locations? How long will the effects last?
- Source of warning – Who is issuing the warning? Is it an official source with public credibility?
- Magnitude – A description of the expected effects. How bad is it likely to get?
- Likelihood – The probability of occurrence of the effect.
- Protective behavior – What protection actions should people take and when?
  - Where/who should (or should not) take the actions (described in clear geospatial, age group, and other everyday terms)?
  - How will the protective actions reduce the chemical's impact?
  - If evacuation is called for, where should people go and what should they take with them?

Once the immediate threat has been addressed, public information communications typically focus on the following topics:

- Overall description of the situation and outline of governmental response efforts
- Instructions on safety measures and risk based on the substance's dispersion method and substance/chemical identity
- Availability of medical and non-medical countermeasures – What is available? For whom? When? Where?
- Locations of supportive care and treatment facilities – What is available? For whom? When? Where?
- Availability of cleanup and remediation technologies, supplies, and personnel – What and who is available? When? Where?
- Cleanup efforts – Who is responsible? How long will it take? What will it cost? What danger is there for humans, wildlife, or the environment until the cleanup is finished?
- In a food/agricultural event – Is the food supply safe?
- In a pharmaceutical event – Is the drug supply safe?

Coordination Opportunity

Hold a tabletop exercise in your jurisdiction that uses locally-tailored emergency planning and communications guidance. Include members of the response community from all levels—decision makers, first responders, public works staff, and communicators—and use this opportunity to see what other questions come up. Some questions may be answered by your plan and your pre- scripted messages, but others may inform how your jurisdiction shapes and updates its communications plan.

Refer To

For help designing effective messages, refer to:

- HHS/CDC Risk Communication Resources[47]

For Leaders/Responders:

- *Public Health Emergency Response: A Guide for Leaders and Responders* is specifically tailored for public officials (e.g., mayors, governors, county executives, emergency managers) and first responders (e.g., police, fire, EMS).
- *Communicating in a Crisis: Risk Communications Guidelines for Public Officials* (2002). This primer educates public officials on the basic skills and techniques needed for clear, effective communications, information dissemination, and message delivery, and on working with the news media.
- *Crisis & Emergency Risk Communication (CERC) Manual* draws from lessons learned during past public health emergencies and provides trainings, tools, and resources to help

communicators, emergency responders, and organizational leaders communicate effectively during emergencies.

For Media:

- *Terrorism and Other Public Health Emergencies: A Field Guide for Media*. This guide provides information for the media on how to quickly and clearly communicate terrorism and public health emergency messages to the public.

Action Item

- Develop chemical incident-specific, accessible public messaging and communication strategies prior to an incident. Begin by patterning after existing all-hazards communications plans.
- Develop messages using simple, action-oriented language to help the public absorb information. Work to simplify protective action messaging while remaining technically accurate.
- Familiarize communications staff with existing pre-scripted messaging resources
- Determine possible points of confusion in safety instructions for your community, and draft messages to deconflict
- Determine a review process for emergency messages
- Utilize exercises or real-world scenarios to practice and refine the review chain
- Socialize draft messages with decision makers to gain pre-approval for dissemination
- Establish a process to catalog, categorize, and answer public questions during an emergency and test the process by storing pre-approved messages
- Talk with other jurisdictions in your area to determine the best way to share cataloged and approved responses to common public inquiries

5.3. Timely Dissemination of Messages

In addition to a defined pre-approval process, planners should consider developing communications protocols that give response personnel the authority to disseminate pre-approved and/or time sensitive, newly created messages if they are unable to contact Incident Command staff. Pre-scripted messaging can even be pre-recorded to speed information dissemination in situations in which some communications systems are offline. Communications planners should discuss the implications of and considerations for this type of independent dissemination plan with emergency management, first response, public works, and SLTT staff so that appropriate procedures can be included in communications plans. In addition, contingency communications agreements with neighboring jurisdictions (discussed above) can be activated so that neighboring officials can step in to disseminate immediate protective action messages to people in the affected area when dire circumstances arise.

Note that comprehensive sharing of communications plans with nearby jurisdictions includes sharing the locations of special populations, locations of concentrated numbers of people, and best methods of communication (preferred platforms and news outlets) in the affected area; defining these is discussed further below.

Finally, developing a pre-identified cadre of individuals who can serve as spokespersons or trusted sources of information for the community can be an effective way to augment immediate message dissemination capacity. This cadre must be prepared (via media training) to effectively deliver key information, particularly regarding protective actions guidance, almost immediately following an incident in order to maximize lives saved. Local spokespersons such as fire and police chiefs and local broadcast meteorologists are considered credible sources of information. In some cases, it may be necessary for the responding federal On-Scene Coordinator (OSC) to communicate with the media/public on tactical operations and matters affecting public health and safety directly from the scene, particularly during the early stages of the response.

Action Item

- Institute a standard operating procedure (SOP) that ensures critical lifesaving messages are disseminated when it is not possible to reach the jurisdiction's usual chain-of-command
- Discuss the planned SOP with all stakeholders, including staff from related agencies and local decision makers
- Coordinate with nearby jurisdictions to ensure publication of immediate lifesaving messages for the surrounding areas
- Familiarize neighboring jurisdictions with communications preferences in your jurisdiction
- Identify potential spokespeople, and discuss the potential need to use their skills during a chemical incident response
- Provide media training for technical experts, like scientists, public health officials, and first responders and regularly rehearse technical experts interacting with real or simulated media

5.4. Use of Duplicative Outlets for Message Dissemination

Options for addressing the third critical factor for ensuring the effectiveness of public communications for lifesaving and injury prevention, message dissemination, are many. Plans should include a SOP for those specific methods that will be used to communicate protective action directives within the jurisdiction. In general, dissemination channels should be agile and immediate, and able to handle frequent updates. The methods chosen should be informed by community usage of platforms and outlets and communicated to the public during preparedness campaigns so that they know where to find and receive emergency information, especially if certain systems are down (see below). The simultaneous use of several alert and warning methods is recommended as people often seek confirmation through observation or querying others prior to taking a protective action. Multiple channels of communications can facilitate this confirmation. Further, different communication channels may reach different at-risk populations. Additionally, depending upon the specifics of the incident, it may be difficult to reach those in the affected area. For example, cellular connectivity may be lost for days after a natural disaster such as a hurricane or an earthquake; this may be the time period during which a chemical incident also occurs.

Go beyond "Printed Statements." To reach a broader, non-technical audience, balance published statements with public remarks, supplement heavy text with graphics, and design agency websites with end users in mind.

Emergencies typically will prompt a deluge of calls, texts, and social media messages to people in the affected area, overloading cell towers and making communications sluggish. Be aware that communication platforms can be overloaded or otherwise inaccessible in the immediate aftermath of a mass casualty incident; additionally, some large incidents can actually "take down" communication. In some instances, authorities may need to halt or limit communications for security reasons.[48] Communications planners should consider developing a specific prioritization of alternative dissemination pathways to implement when available systems are limited, as well as critical messaging to deploy over these pathways. Although responders should first attempt to send messages through the "usual" channels, plans should include protocols for the use of alternate means of communication as well, including communication with responders and other critical partners.

FEMA's Integrated Public Alert and Warning System (IPAWS) provides significant capability for public messaging, including capability to broadcast an alert message to all cellular phones in a given area as a Wireless Emergency Alert (WEA), access to the Emergency Alert System, the National Oceanic and Atmospheric Association All Hazards Weather Radio network, and internet- connected alerting tools. WEA can be leveraged to deploy geo-targeted messages that alert recipients to imminent safety threats in their area. Geo- targeted messaging can be a boon for responders when immediate evacuations or sheltering-in-place are needed to save lives in some but not all local areas. Using WEA, people in the affected areas can be precisely targeted with directives for safe movement, avoiding confusion in people in other areas or a flood of information that could cause improper action in critical areas. During planning, the limitations of the WEA system, including the frequency of message sending and the languages available, should be explored and mitigation strategies considered. Responders should also be familiar with which communication channels work under adverse network conditions as emergencies can adversely impact communication technologies.

Communications staff should disseminate safety messages on all digital platforms on which the agency or jurisdiction has a presence, leveraging the speed and breadth of their combined information-sharing capabilities. This includes social media platforms, and may also include government app notifications, alert text message platforms, and partner organization platforms. Establishing an official media presence pre-incident or early during an incident helps bolster the public's view of the validity and credibility of the information being provided.

Action Item

- Develop a pre-incident plan for implementing alternative communications systems
- Establish a verified and consistent presence on social media platforms to establish credibility and gain followers in your community
- Identify social media platforms to prioritize message delivery during an emergency
- Create re-worded versions of safety and other messages for deployment on social media during an emergency
- Be familiar with communications capabilities such as IPAWS and WEA
- Ensure that your jurisdiction has designated individuals authorized to send WEA messages and exercise executing targeted WEA message deployment
- Determine how your jurisdiction will send specific messages to different geographical locations
- Talk with local organizations and businesses to encourage participation in immediate notification exercises
- Contact local cellular providers to discuss emergency plans and considerations

Coordination Opportunity

Practicing the deployment of geo-targeted messages is necessary to ensuring effective utilization of this strategy during an emergency. Including community groups, school officials, local businesses, and other stakeholders in this test will allow communications staff to receive valuable and trusted feedback before an event occurs and will help them tailor the alerting strategy to best fit the community's needs.

Refer To

For more information on how to access IPAWS, the criteria for issuing warnings, different message categories, event and hazard-specific names/codes, and to become authorized to send alerts, see the following FEMA-sponsored training courses:

- [IS-247.B]: *Integrated Public Alert and Warning System (IPAWS) for Alert Originators* and the review study guide
- [IS-251.A]: *Integrated Public Alert and Warning System (IPAWS) for Alerting Administrators* and the review study guide
- *FCC Wireless Emergency Alerts (WEA) system*

Figure 43: Coordination in message content and delivery planning is vital to ensure a common message is delivered to the right areas at the right times throughout the response

6. Strategies for Effective Communications

To have the best chance for success, public communications campaigns for chemical incidents must include more than just the delivery of protective action and other response information to the public. Effectiveness of communications throughout all stages of response and recovery will be fostered by the development of comprehensive and flexible communications plans, strategies, and content before an incident occurs and by cultivating and maintaining relationships with the public throughout response and recovery. This section discusses several considerations, strategies, and activities that can promote effective communications activities during planning, response, and recovery, as follows:

- Understand your audiences
- Conduct pre-incident preparedness campaigns
- Secure technical assistance
- Communications considerations for large-scale, intentional, and/or unattributed incidents

Figure 44: Holding "town hall" style community meetings and preparing official spokespersons to speak with news media are important communications strategies

6.1. Understand your Audiences

Understanding the cultural background, history, location, primary language, values, accessibility needs, etc. of your community's various "audiences" is key to designing an effective communications strategy for any crisis or emergency situation.[49] To maximize lifesaving and minimize community disruption following a chemical release, each individual audience's needs must be met during advance message preparation and approval. In-the-moment, there may not be enough time to translate, simplify, or rephrase a message. Therefore, the characteristics of the whole community – across all population segments (audiences) – should be defined before a chemical incident public messaging campaign is developed. Tools such as community-wide surveys can be used to:

- Review population data
- Identify locations to focus pre-planning efforts
- Gain insight into the needs and concerns of specific populations
- Identify populations that may benefit from different or more specific instructions, including individuals with disabilities and those that support them
- Determine whether additional outreach efforts may be required to reach certain groups
- Collect actionable planning data related to information access and availability during catastrophic incidents
- Identify businesses, neighborhoods, or groups with existing emergency communication plans
- Identify common sources of information/preferred methods of communication for the population

These surveys should identify non-traditional community groups that live, work, and gather in the community, such as farmers, the homeless, workers from other towns, people shopping, tourists, and people commuting to schools. In addition, the surveys should strive to reach traditionally undervalued, underrepresented, and underserved (U3) populations including elderly, disabled, non-documented, and homeless populations, racial and ethnic minorities, people with limited English proficiency, those impacted by the digital divide, LGBTQIA+ communities, etc.

Information collected from such a survey will help public communications staff develop successful whole-community messaging campaigns. Such campaigns can be expected to include a variety of messaging types for use during a chemical incident to ensure that all persons have equal access to the information. For example, schools will need more focused messaging than the general population, and large groups of people with limited English proficiency will need messages translated into their native language(s). Audiences such as parents of schoolchildren and people with disabilities, limited mobility, and others may have questions about protective action directives that the general public does not. Farmers may require specific instruction about how to best protect their livestock, or what they may need to do with their crops. In addition, discussing the specific considerations needed by different groups with first responders (police, fire, EMS, etc.) will help them understand the different audiences within the community and any additional instructions they might receive before or while responding.

Thinking more broadly, a list of anticipated public questions from wider audiences can be formulated; these should address the concerns of both affected and non- affected localities as well as the regional, national, and international community.

Figure 45: Involving the community in chemical incident planning builds public trust

Community surveys are also a good place to start building public trust in chemical incident planning efforts. Initially, many people and organizations (businesses, schools, etc.) will be frightened by being asked to consider the possibility of a chemical release scenario happening. Surveys that explain why they should plan for a chemical incident will go far toward gaining their trust. Existing emergency plans can be shared among similar facilities and used as a starting point for chemical incident-specific planning. These discussions present an opportunity for preparedness outreach and trust building within the community as organizations work together to plan for local risk scenarios.

Coordination Opportunity

Encourage local organizations to share existing emergency plans and work together to develop chemical-specific emergency plans that are tailored to local chemical risks. Encourage the creation of plans for locations where people tend to gather in the community.

Refer To

New York City's *Community Emergency Planning Toolkit for NYC Community and Faith-based Networks* is a good model to consult when beginning to design and scope your survey needs. Performing such surveys will be different for each community; the toolkit recommends leveraging existing knowledge bases/other stakeholders in the community.

Action Item

- Work with other agencies and organizations to develop, design, promote, and deliver a community survey
- Analyze survey data to determine which locations may need additional support in planning for large-scale emergency responses, including chemical release scenarios
- Identify populations with specific accessibility, messaging, and operational needs and note what types of messages and message delivery systems will be needed for these groups
- Work with community groups to ensure messaging plans are based on a diversity of opinions and have been checked for unintentional bias
- Work with community groups to formulate anticipated public questions based on the interests and needs of the community and draft messages to address these questions
- Work with schools to create effective emergency response drills for their students
- Determine which public-preferred news sources are among top choices for use in your jurisdiction. Include emergency notification software such as Everbridge, Emergency Alert Systems, and other programs.
- Identify which news outlets, social media platforms, and community leaders are the preferred sources of information in your community

What Will You Need to Know?

- ☐ Where do populations live, work, and gather?
- ☐ Who works in the community, and who commutes into the area?

- ☐ Does the community have places of worship that meet or gather on different days of the week?
- ☐ Where are schools, daycares, assisted living facilities, shopping locations, and other community gathering locations?
- ☐ Where are the most densely visited locations during the day?
- ☐ Where are people during the day, evening, or at night on a typical weekday? What about over the weekend?
- ☐ What non-traditional groups and special populations live, work, and gather in the community?
- ☐ Where are traditionally undervalued, underrepresented, and underserved (U3) populations?
- ☐ Which groups need specific or tailored instructions?
- ☐ What tools are available to ensure communications are accessible to all, including those with hearing or vision impairments?
- ☐ Which local venues have existing emergency plans (for any incident)? Do they have communications plans for large-scale catastrophic incidents?
- ☐ What are the community's preferred communication channels?
- Do they generally get news on a social media platform?
- During an emergency, do they look for email blasts or text alerts from official organizations?
- Do local media outlets have trusted reporters, anchors, or influencers who are well known to members of the community?
- ☐ Which platforms are most frequently visited and used?
- What are the community's preferred social media platforms?
- Which cellular providers are used in the community?
- ☐ What languages are spoken, preferred, and understood in the community?

6.2. Conduct Pre-Incident Preparedness Campaigns

The effects of chemical incidents and chemical exposures are not well understood by most, and as a result, are feared. A lack of knowledge about the subject makes it difficult for people to feel like they are in control. Together, these factors make a chemical emergency difficult to message. However, the public's familiarity and perception of control can be enhanced through pre-incident education. In fact, communicating knowledge and key messages before an incident increases the likelihood that the public will heed messaging during an incident; this could mean that they will heed directives to shelter-in-place, protecting themselves from potential exposures rather than following their natural instinct to run from danger.

Preparedness messaging strategies that focus on action help the public feel more in control of an emergency, retain information, and make better informed decisions during an actual incident.

Cultivating pre-incident awareness within the general public is difficult. The public is often skeptical of preparedness messages; without an immediate need for the information, people may question why the campaign is happening in the first place – what do you know that I do not? Moreover, if the public associates chemical exposures with certain injury or death, their sense of futility, fatalism, and hopelessness severely diminishes their desire and their ability to absorb information and follow instructions. Preparedness messaging strategies that focus on action help the public feel more in control of an emergency and help them retain information and make better informed decisions about their safety and the safety of their loved ones during an actual chemical incident.

The public is more likely to embrace learning about protective actions for a chemical incident if they understand that these are often the same actions they take for more familiar emergencies. For example, if the community regularly prepares for tornadoes, they will be familiar with the sheltering during an emergency. If the community is used to preparing for severe weather events, they will be familiar with the need to maintain first aid kits, non-perishable food, and bottled water for multiple days. Grouping CBRN preparedness actions together for a more holistic approach to preparedness may be also useful; the public may envision integrated chemical, biological, radiological, and nuclear (CBRN) events as just “one more thing” to be prepared for.

Discussing specific concerns and questions with potentially impacted communities across population segments before an incident occurs will help communicators ensure their preparedness messaging strategies will meet the community’s needs. Brainstorming meetings or informal community meetings are good avenues to gain community input and insight into educational campaign development and will further build relationships and trust within the community. For example, since people with children are more receptive to public safety instructions about sheltering-in-place if they know that their children are being taken care of, preparedness campaigns should include discussions with parents about where and when they would be able to reunite with their children following a chemical incident.

In addition to transmitting chemical incident-specific knowledge, preparedness campaigns should encourage simple technology hygiene and preparedness emergency practices, like knowing when to use text messaging rather than phone calls, and when to turn off automatic downloading of images and videos when using data to retrieve social media feeds. These simple actions can prevent cell towers from being overloaded to the point that communications are lost during an incident.

Preparedness campaigns should also include education on the potential methods that emergency managers, public health officials, and responders will use to communicate with the public (e.g., cellular, radio, etc.) so that residents know where to quickly access public health and safety messages during an emergency. Campaigns should include education on local emergency notification platforms – including additional exposure to the Emergency Broadcasting System – and understanding what emergency siren tones mean.

6.2.1. EMBRACE TEACHABLE MOMENTS

A teachable moment is a time at which learning a particular topic or idea becomes possible. A heightened awareness of chemical threats or emergencies stemming from international events, historical anniversaries, the release of periodic cleanup reports from past emergency sites, or news of a chemical emergency happening elsewhere may trigger a teachable moment in your community. In these moments, people consider how they would react or respond in a similar situation, for example, a local chemical incident. Generally, when people are feeling underprepared and are concerned by the gaps in their knowledge of how to protect themselves and their loved ones, they are more willing to listen to preparedness messages without being frightened by the messages themselves. As teachable moments are rare, unplanned, and fleeting opportunities, lasting for only a few days at most, it is critical that officials be ready to fill knowledge gaps with the release of pre-approved preparedness messages that teach the public how to respond following a chemical incident.

Figure 46: Take advantage of teachable moments in the community, fleeting times at which learning potential is heightened

Coordination Opportunity

Gather support for preparedness campaigns from a coalition of decision-makers, public health, and other agencies in your community. Create a broad-reaching campaign through community outreach, school outreach, and public service announcements (PSAs). Be careful to note that the campaign is not in response to a known threat, but simply one more thing people should know to be prepared for any emergency. Gaining organizational and community backing, including from public health, emergency response, and communications experts from various agencies, before a campaign starts can be crucial to its success.

Via community meetings, discuss chemical incident-specific concerns and questions with people across population segments (audiences). Such meetings are good avenues to gain community input into educational campaign development and will further build relationships and trust, as well as helping ensure preparedness messaging strategies will meet the community's needs.

Action Item

- Discuss the need for pre-event preparedness as a lifesaving technique for a chemical release scenario with elected officials, upper management, and community leaders
- Identify successful outreach campaigns within your community on which to model chemical preparedness outreach campaigns
- Consider how to integrate chemical incident awareness materials into existing preparedness campaigns
- Develop a strategy to take advantage of "teachable moments":
- Pre-draft and approve messages for immediate deployment, and determine which communications channels are best suited for a teachable moment scenario in your community
- Create a strategy to reach parents of children in schools and daycares with emergency preparedness messaging
- Work with schools and daycares to understand the best way to include chemical release preparedness and messaging in preparedness campaigns
- Design a campaign that will enhance understanding of existing shelter-in-place and evacuation protective action directives
- Design a campaign that exposes the public to the Emergency Broadcast System and siren tones
- Identify alternate means of communications for your community and your responders and socialize alternate communications plans with the public and with responders
- Incorporate digital hygiene best practices into preparedness campaigns to increase data availability during an emergency

6.3. Secure Technical Assistance

The inclusion of simple chemical risk translation, technical messaging, and reasoning in protective action and other pre- and post-incident communications will increase their effectiveness. Integrating a chemical technical advisor/subject matter expert into the communications team as early as possible during (or, preferably, before) the incident will enable the team to draft language for response agencies, responders, and the public that clearly and simply explains chemical-specific risks, clarifies the importance of recommended protective actions, and addresses responder and public concerns about exposures. Pre-incident, an advisor can help pre-prepare information specific for local chemical risks and can help incorporate such information into plans, job aids, and checklists to ensure decision makers have access to critical technical information early in an incident when they are establishing response priorities. The advisor can also translate technical information for other communications staff and distill the large amount of information flow following a chemical incident down to the most critical elements of information for messaging the public and responders. When rumors and mis- and disinformation about the incident appear across social media platforms, a technical advisor can quickly assess questionable messages and assist in drafting messages to counter misinformation and promote official guidance. Finally, some messages are best delivered by scientific experts, and for some platforms and media types, like live interviews, a technical expert should be in front of a camera.

Understandably, few jurisdictions have a chemical expert on staff. Instead, jurisdictions should identify where these resources exist in their community and explore options to close gaps in this expertise. An advisor may be available from community, state, or national organizations where chemical professionals are already in place, such as state occupational health or environmental protection agencies. Alternatively, a Chemical Operations Support Specialist (COSS, see below) located in the state or region may be available.

6.3.1. TECHNICAL COMMUNICATIONS ASSISTANCE: FEMA'S CHEMICAL OPERATIONS SUPPORT SPECIALIST (COSS) PROGRAM

The Chemical Operations Support Specialist (COSS) program is designed to fill a chemical incident response gap: there are too few chemical experts who can integrate seamlessly into emergency management operations. COSS are a NIMS-typed resource developed through FEMA's CBRN Office. As a chemical safety professional, a COSS can integrate with the incident command system to provide expert chemical information to responders and emergency managers. COSS are also trained to know what federal resources can be leveraged to assist if needed. Perhaps their most important skill, however, is supporting effective communications in times of crisis. COSS are specifically trained to serve as communicators; they can assist PIOs and other communications staff, members of the IC/UC or JIC, and other communications channels. COSS can help distill the large amount of information flow following a chemical incident down to the most critical elements of information for messaging the decision-makers, responders, and the public.

A COSS can also be invaluable asset during chemical incident communications planning, training, and exercising. A COSS can help develop and refine communications plans and pre-scripted messages in these stages.

Action Item

- Contact FEMA-COSS@FEMA.DHS.GOV to establish a link between your jurisdiction and the COSS program

- Utilize COSS to assist in drafting your jurisdiction's response plans for a chemical incident
- Identify where COSS may be able to support communications work during a response in your plans

6.4. Communications Considerations for Large-Scale, Intentional, and/or Unattributed Incidents

Whether small or large in scope, a chemical attack on American soil will almost certainly be a leading topic of worldwide reporting and interest. Even an unintentional chemical incident that is large in scale will attract 24-hour, multi-platform, multi-outlet interest and regional, national, and multi-national coverage. More locally, a mass casualty chemical incident will likely incite feelings of fear, anger, and grief within the public at large, which will manifest as many thousands of public inquiries. For unattributed incidents, including food incidents for which the contaminated product has not yet been identified, the longer the delay in identifying the source of the contamination, the more uncertainty and fear will spread. In all these cases, wide reporting by media outlets can be expected. Local public information officers and communications teams will be immediately overwhelmed by inquiries and will need the of support public affairs staff from neighboring jurisdictions and state and federal agency and private sector partner communications offices.

During and following mass casualty incidents, officials will be questioned nonstop about what happened, what actions are being taken, who was responsible, and "who knew what, and when did they first know it." However, official communications must always show that everyone's priority is to protect the public and the environment and focus on the actions being taken to do so. Early in the response, messages to the public and the press must remain clear, concise, and consistent, providing vital information on protective actions without instilling additional fear or causing panic. The lead PIO should prioritize which information requests are most important for public health and safety, and direct staff to draft and review responses to these requests. In the instance of a terrorist incident, the FBI must be consulted before issuing sensitive media/press releases.

Planners should coordinate with and educate common media outlets before an incident occurs to ensure the media understands their role in reinforcing the protective action messages that are important for saving lives and protecting the environment early on during a chemical incident. The Department of Health and Human Services has created media guidance that discusses how to quickly and clearly communicate terrorism and public health emergency messages to the public.[47,50] This guidance is helpful to creating a baseline of understanding of chemical safety science for reporters, whether or not the incident is the result of terrorism (although it cannot be guaranteed that they will reference this guide), or an accidental release. Further, once the source of contamination is identified in previously unattributed incidents, the media may be needed to help minimize future exposures by assisting in warning the public. In a large-scale food contamination event, these timely, effective warnings may prevent tens of thousands of individuals from being exposed.

Coordination Opportunity

Work with local media outlets before an incident occurs to ensure the media understand the key role they play in reinforcing the protective action messages that are important for saving lives early in a chemical incident. Provide the media with emergency communications resources and encourage them to participate in preparedness exercises.

Refer To

HHS's *Terrorism and Other Public Health Emergencies: A Field Guide for Media* and additional emergency communication resources from the HHS CHEMM platform.

Action Item

- Establish plans to reinforce communications staff within your response structure
- Ensure strategies for messaging in an event with uncertain cause provide information without causing fear or panic
- Develop a prioritization tool to ensure messaging efforts are focused on lifesaving first
- Practice prioritizing messaging needs with staff through exercises and targeted public information training
- Practice redirecting questions to focus on critical life-safety messages with potential spokespeople
- Discuss the importance pre-event education with media outlets, and assist in providing training

6.5. Communicate Throughout Response and Recovery

Communications should establish early in the response that the event will likely continue to evolve over time, and that messages, including human health and environmental safety instructions, will be updated to reflect current conditions and new information as it is gathered. Continued messaging that includes information on ongoing response and recovery efforts helps the public understand that work is being done hours, days, even months after the incident. The messages should include simple explanations of what work is ongoing, why it is helpful to the public, and how it informs current and future public health and environmental safety or other guidance. Through close collaboration with chemical, decontamination, remediation, and health experts, tailored messages can be developed that answer anticipated questions about the incident cleanup progress, occupational health concerns, and the potential need for personal protective equipment while impacted individuals clean up homes, yards, vehicles, and other property items. Continued messaging that includes these types of information will help maintain public trust and provide reassurance that the response is ongoing.

As discussed above, some messages can be prepared ahead of time for immediate deployment during and after an incident. Others will need to be written as a critical ongoing component of the response and recovery processes. Communications staff will need to stay updated on the incident cleanup to develop accurate messages that answer the community's questions about the recovery process. With advanced planning by communications staff, methods for the rapid adaptation of messaging as response actions and/or public perceptions change can be developed. Members of the message approval chain should understand that, to maintain message accuracy, they may have to review and approve similar messages with small alterations multiple times. The catalog of questions received and "bank" of approved, reusable answers mentioned above will continue to grow throughout response and recovery and should be used to help address ongoing inquiries being received from reporters and the public, many of which will be repeat questions.

Frequent updates from an official account on social media, even when no new information is available, are a recommended best practice to ensure people will continue to look to official sources for information. The messages should be reworded slightly each time, even if the same information is being posted; this encourages people to continue checking official information sources instead of looking for information elsewhere. Reposting content from other official sources and organizations, and encouraging followers to do the same, helps boost posts on social media and increases the visibility of the content.

Social media platforms should be monitored and analyzed to identify common questions, rumors, concerns, and immediate needs. This information can help inform the structure and content of ongoing response and recovery messaging. For example, social media may be used to promote rumors and mis- and disinformation about the incident and related safety instructions. A chemical technical advisor can quickly assess questionable messages and assist in drafting messages to help counter this.

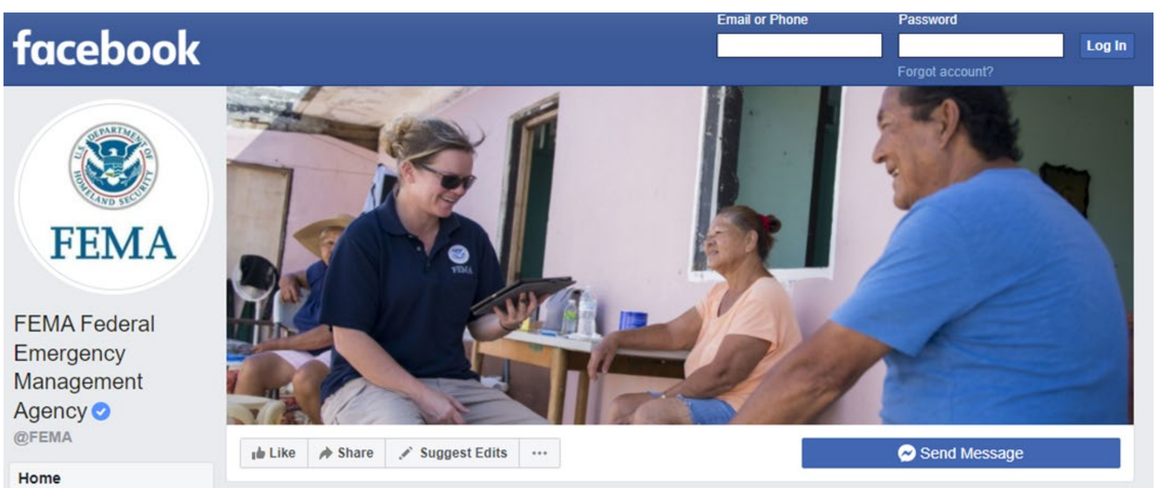


Figure 47: FEMA's Facebook page

By the time the jurisdiction enters the recovery phase, response actions will have become more familiar and routine. Recovery phase messaging, therefore, will be informed by the extended nature of post-incident activities rather than the immediate need for critical lifesaving messages. Further, later response and recovery messaging should reflect the fact that public communication is a two-way street. During the potentially many months of incident recovery, many decisions will be made at a community level. For example, input from community members will be crucial for establishing cleanup priorities and clearance goals. Developing specific message content for the community's different audiences should be continued.

Predetermined messages, also known as talking points, are as crucial during the recovery phase as they are at any other point, and should be drafted and approved in advance. While communications staff may be fielding fewer questions from national and international press outlets, the high level of interest from local and nearby news will be sustained. Further, communications staff will receive emotionally charged and challenging questions throughout the recovery process– there will be more nuance to questions and answers, and members of the community will still feel extremely vulnerable. Meanwhile, communications staff themselves will be facing burnout, re-traumatization, and continued grief and loss that will likely affect their morale and efficacy.

Action Item

- Plan for regular updates to the public
- Plan for consistent communication on a regular basis through social media, press releases, and press conferences
- Discuss the importance of timely review with leadership and decision makers in your community
- Discuss the need for continued review of previously approved messages during a chemical incident
- Anticipate potential questions from various audiences in the recovery phase of a chemical incident, and draft answers to these questions
- Create versions of answers for communities that have suffered differently
- Explore and exercise the use of digital media monitoring

6.6. Communicate with Empathy: Create Validating and Empathetic Messaging

Following consequential chemical incidents, particularly large-scale and mass casualty events, the public most likely will be experiencing strong emotions. They may have been displaced, be facing economic challenges including loss of homes and livelihoods, or have been injured or lost loved ones. They may feel frustration with the speed of the response and a potential perceived lack of urgency in achieving recovery outcomes and reoccupation of their homes or businesses. Empathetic messaging is a critical tool for sustaining the community and their continued support during difficult times. Validating the public's fear, grief, and sadness before giving more information or instruction helps the public feel like their concerns are being heard and taken seriously and increases their trust in the response and recovery process. Regional coordination of messages to encourage continued support for people displaced by the incident, and for people continuing to respond to the incident, will be worthwhile.

From a communications perspective, this means that messages of empathy and validation must be prioritized. Thus, it is critical that staff plan communications strategies that address highly personal and potentially volatile topics, including mental health, reoccupation, and loss-of-life. Remember, too, that these factors affect response staff as well as the public.

6.6.1. MENTAL HEALTH COMMUNICATIONS

Following a chemical incident, especially a large-scale or intentional incident, the affected population – including responders – should be advised regarding common behavioral and mental health effects of such stressful situations. Community-wide advice on individual and group resiliency strategies should be provided, along with information regarding available professional help and counseling. Open, honest, and frank communication about how individuals in the community are feeling helps increase trust and can help the public determine when someone they know may need professional mental and/or behavioral health help. (See KPF 5, Augment Provision of Mass Care and Human Services to Affected Population, for further discussion of post- incident mental health challenges.)

6.6.2. DISPLACEMENT/REOCCUPATION COMMUNICATIONS

Both the initial physical removal of people from their homes and their communities, and the need for extended population displacement due to health and safety concerns, will cause distress and other strong emotions. Messages should validate the experience of being displaced and encourage engagement with community cleanup processes, volunteer work, and other activities that may give people a greater sense of control over the situation.

Depending on the spread of contamination in an area, some residences, workspaces, and other facilities may be decontaminated and/or cleared for return quickly, while others may require long-term work and construction to mitigate contamination. Still others may never be reopened for return. The apparent inconsistencies in clearance will likely confuse and concern people who have been evacuated and raise questions about why some can return while others cannot. Messages surrounding return, relocation, and displacement should be clear and consistent and reiterate decision based on health and safety considerations. If levels of contamination are above established or agreed-upon protective limits, messages should talk about why returning to these areas would be dangerous. When discussing protective exposure limits, messages should explain why they afford appropriate protection, as well as the risks involved in exceeding these limits. If the expected dose is too low to cause health effects, state that explicitly.

6.6.3. LOSS-OF-LIFE COMMUNICATIONS

Injury and death tolls from a large-scale chemical incident could range in the thousands to tens of thousands. Questions about the total number of people injured and lost will be constant; staff should not speculate on the conditions or numbers of people involved, but stick to confirmed facts. A mass casualty chemical release scenario could also have lasting effects on the health of residents and workers in the area for years to come.

There is no perfect way to acknowledge and answer loss-of-life questions. Pain, loss, and grief will always be attached to the event. Communicating respect and care in answers to these questions is therefore crucial from a public trust perspective. Acknowledgements of loss should come from a trusted member of the response— likely a trusted member of the affected community—and must come with a commitment message to the loved ones of those who died.

Recognize, too, that different faiths and cultures deal differently with death. The U.S. Department of Health and Human Services and SLTT public health agencies may be able to share information about these differences so they can be understood and respected in messaging. There will likely be questions about religious considerations in recovering and burying or cremating the remains of those who perished in the incident. The recovered remains may be contaminated (and/or considered evidence) and, therefore, will not be able to be given to the next of kin for burial or cremation. People who lost their loved ones will have to cope with the fact that they may never be able to bury their loved ones in the way designated by their religion. Again, providing empathetic and validating, accurate, and specific fatality management messages will increase the public's confidence that fatality management is being handled with the utmost care and respect. Work closely with emergency planners and the response cadre to get as much specific information about fatality management as possible, and make sure to keep the public informed about plans, preparations, and actions taken to recover bodies.

Talking about the people who have died will be one of the most harrowing aspects of a communicator's job. There is little advice on how to do this and there is no template to follow. Messages written with compassion, vulnerability, and strength will help the community begin the recovery process and provide a sliver of closure and comfort to people who have lost a great deal.

Action Item

- Work with staff to develop good empathetic messaging techniques
- When pre-scripting messages, keep the focus on empathy and commitment
- Socialize draft messages with decision makers, inter-organizational staff, and other groups with differing perspectives and authorities
- Identify mental health resources available in your jurisdiction

- During exercises and throughout the planning process, talk with communications staff about the mental strain that will occur during an actual event
- Include communications staff, both inside and outside of the response structure, in responder mental health training and discussions
- Plan for gaps in coverage in staffing during the recovery phase as responders tend to their loved ones and homes
- Consider best practices to support staff who have themselves been affected by an incident
- Include staff support mechanisms in planning
- Practice explaining varying chemical risk levels during exercises and in trainings
- Work with chemical subject matter experts to understand how best to communicate how data informs decision-making
- Incorporate fatality management as a topic of needed messaging into planning
- Enlist the support of professionals who regularly communicate about death
- Research cultural differences in dealing with death and burial
- Discuss the emotional strain of messages related to fatality management with staff who will have to draft them
- Work with Regional FEMA counterparts to learn how to take advantage of the Crisis Counseling Assistance and Training Program (CCP)

7. Best Practices for Communicating Risk in an Emergency

(Adapted from the UPMC Center for Health Security's 2016 "How to Steward Medical Countermeasures and Public Trust in an Emergency")[40]

Figure 48: Provide trusted spokespersons to news media outlets

1. Embrace communication as an essential part of "front-end" decision-making.
2. Incorporate communication experts at the outset when developing emergency management policies.
3. Conduct pre-event communication planning that identifies potential threats or hazards, outlines risk reduction approaches, recognizes the resources needed to implement them, and spells out the responsibilities of principal actors.
4. Build pre-crisis partnerships and alliances with other stakeholders to coordinate the sharing of communication resources and activities, enlist their help in better understanding and reaching target audiences, and establish trusted links that can be activated during the crisis period.
5. Recognize the public's right to know the risks that it faces as well as protective actions that it can take, and plan for the prompt sharing of this information.
6. Accept uncertainty and ambiguity, and acknowledge the potential need to act before all the facts are known. Be prepared to explain the fluidity of conditions and the measures being taken to fill in the knowledge gaps.
7. Listen to the public before and during the emergency. Find out what people know, think, or want done about risks, and use this to inform communication and emergency response planning. Acknowledge people's concerns and adapt messages accordingly.
8. Communicate with honesty, candor, and openness. Foster credibility with the public and the media. Be frank about the potential severity of the crisis. Promptly make information available. Convey information uncertainties, strengths, and weaknesses.
9. Communicate with compassion, concern, and empathy. Recognize the human dimensions of the emergency and acknowledge people's distress.
10. Respect the unique communication needs of diverse audiences. Be mindful of differences in cultural background, immigrant status, education, technological adeptness, hearing and seeing abilities, and other factors that influence information uptake and processing. Use clear, non-technical, accessible language and graphics to clarify messages; employ multiple language translations where appropriate.
11. Meet the needs of the media and remain available. Plan to work diligently with the media before and during an incident knowing that members of the public often rely on news outlets to learn about a crisis or risk.
12. Convey messages of self-efficacy. Provide specific information to the public on how to reduce any potential harm and what can be done to help others. Protective messages can reduce material harm as well as enhance morale by restoring a sense of control over uncertain and threatening conditions.
13. Monitor public responses and update communication efforts to meet people's evolving information needs.

What Will You Need to Know?

- ☐ Who will gather and synthesize human and environmental health information for public guidance and compliance from SLTT, federal, non-governmental, and private sector partners? When will that happen?
- ☐ How will information be provided to the public on availability of MCMs? On locations of supportive care and treatment facilities? On instructions on risk and protection measures?
- ☐ How will information be provided to the public on appropriate decontamination and remediation agents and procedures? On locations of decontamination facilities? On instructions on risk and protection measures?
- ☐ How will you contact hard-to-reach populations (transient/homeless, foreign students, home-bound, etc.)?
- ☐ Who will monitor the media for inaccurate information that could hinder the effectiveness of the public messaging? How will the monitoring be done and reported to you?

When communicating for chemical incident response:


Communicate with empathy

Incorporate duplicative communications methods

Consider the needs of your community, including vulnerable populations


Communicate with partners to coordinate the response

KPF 4 Control the Spread of Contamination

Stopping the spread of contamination and minimizing additional exposures is a critical response action. By controlling the spread of contamination, lives are saved, the environment is protected, and resources may be used more effectively, thus reducing the overall impact of the incident. Depending on the nature of the incident, controlling the spread of contamination may involve environmental containment and/or remediation efforts; decontamination of people, goods, or property; and interventions such as evacuations and food recalls.

1. Control the Spread of Contamination

Once a chemical incident has been recognized, minimizing the further spread of environmental contamination and preventing further exposure of people and animals is critical. Rapid and efficient steps taken to minimize the spread of contamination can prevent thousands of potentially lethal exposures and devastating environmental effects. Depending on the scenario, the response actions may involve a combination of sheltering, infrastructure shutdown, evacuation, decontamination, remediation, scene control, epidemiological investigation, and/or public information and warning communications. Making full use of the chemical hazard information provided by RPs under EPCRA is critical for minimizing risks when responding to an emergency.

After its initial release and deposition, a chemical may continue to spread throughout the environment by:

- Physical transfer via the movement of vehicles, materials, people, and animals
- Reaerosolization, when a second or subsequent creation of an aerosol occurs creating a fine mist or when many small droplets are raised aloft in the air creating an inhalation hazard, if initially aerosolized
- Resuspension, if deposited out of a water column
- Volatilization, including the vaporization or off-gassing of liquids on clothing, skin, or other materials, or off-gassing of ingested materials through breathing or vomitus
- Continued airborne or waterborne movement

A released chemical may spread via:


Movement of vehicles, goods, and materials


Movement of people and animals


Reaerosolization, volatilization, or continued airborne movement


Resuspension or continued waterborne movement

The released chemical may react with water or other compounds present in the environment to produce potentially more hazardous compounds than the chemical initially released. Thus, chemical spread will increase the environmental impact of the release as well as the number of people who come into contact with the substance and experience subsequent health effects. Critical infrastructure may become contaminated, hampering response operations and reducing the availability of key lifeline services to the region, with the potential for longer-term consequences. Minimizing the spread of contamination will reduce these infrastructure impacts as well as remediation time and cost. In fact, the single most effective means of reducing the level and complexity of wide-area response and recovery activities needed is to limit the extent of contamination within and throughout the area.

Amid activities aimed at preserving unaffected areas and preventing unexposed individuals from being exposed, it is critical that responders are aware of and appropriately manage lingering threats such as the potential for a second release (such as from a damaged rail car), persistent spread of the substance throughout an area, or large quantities of contaminated food. Moreover, when the incident poses a risk to the public, crisis and risk communication strategies should be implemented quickly to ensure the public receives appropriate and timely information and guidance and remains calm (refer to KPF 3, Communicate with External Partners and the Public). Clear communications with the public are key to success in limiting human exposures. The public must be alerted as to what areas to avoid and how to obtain help with decontamination if they are in a contaminated area.

The goals of the response and recovery activities discussed in this Key Planning Factor include:

- Stopping the spread of contamination
- Protecting responder, environmental, and public health through decontamination and other measures

Minimizing the spread of contamination can prevent lethal exposures and devastating environmental effects.

2. Initial Containment and Cleanup

Speed is essential in response efforts, as contaminants can spread rapidly, especially when released into the air or bodies of water. Containment and cleanup activities (or substance recovery) will be more effective if they are carried out before the substance spreads. Moreover, quick and simple actions taken early in incident response that minimize the released volume and the area contaminated can substantially reduce cleanup time, effort, and cost.

The strategies available for limiting chemical spread are highly chemical-specific and situation-dependent. Effective environmental control methods differ with each chemical, and different approaches will need to be taken depending on the substance's physical and chemical properties, the release medium (air, soil, sediment, groundwater, or surface water including offshore), and site-specific factors. First responders should have access to several options for immediate spill control as they are generally expected to make a good faith effort to stabilize the scene to keep contamination from spreading. This section reviews different techniques and technologies for the immediate control of the spread of contamination following releases on land, including from transportation accidents, and in bodies of water both inland and offshore. Discussions of long-term remediation strategies and considerations for the transport and disposal of the wastes generated during these processes can be found in KPF 7, Augment Essential Services to Achieve Recovery Outcomes.

Containment actions are informed by the chemical's physical properties and environmental conditions.

Action Item

Planners should familiarize themselves with state, regional, and local plans for environmental containment and other actions to prevent contamination spread.

2.1. Contamination Control Mechanisms

Major approaches to controlling the spread of contamination include the following. These are discussed in more detail below with respect to their application on land and in bodies of water, with a special focus on oil release incidents:

- Containment – Mechanical containment efforts limit the area of release. This includes approaches that restrict the chemical material to within its original container. Recovery of the material may be possible.
- Neutralization – Chemical and physical treatments neutralize, solidify, precipitate, etc. the substance, reducing its risk to human and environmental health.
- Sorption – Chemical and physical treatments absorb or adsorb the substance, enabling its collection for disposal and in some cases (for example, in some oil spills), recovery.
- Dispersal – Chemical and physical treatments speed dilution of the substance, effectively removing the hazard by lowering its concentration ("flushing").
- Vapor suppression – Chemical and physical treatments suppress vapor generation by volatile substances.

Figure 49: Containment control mechanisms: neutralizing mining wastewater (left) and moving an oil containment boom (right)

2.2. Incidents on Land

The contamination control techniques discussed below are commonly applied - often concurrently - during incident responses on land.[51,52]

- **Containment and recovery.** Preventing land-based releases from entering nearby waterways is a high priority in controlling contamination spread. Traditional containment techniques include diversion, diking, ditching, booming, fencing, and damming or berming. These are also performed to keep surface and storm water out of contaminated areas. Contained substances may be recovered for disposal or reuse.
- **Neutralization.** Physical techniques for neutralization include the use of solidifiers on spilled liquids, which enables the rapid containment and isolation of hazardous substances. Placing the solidifier at run-off points or at the edges of the spill allows the reactant solid to automatically create a barrier that slows or stops the spread of the released material. Chemical techniques include the application of neutralizing substances to acids or alkalis, or stabilizing substances to reactives. Released materials, especially petroleum products, may be removed from the environment by controlled in situ burning (burning in place). In some instances, a controlled burn is the safest way to remove a chemical hazard; as described in the Prologue, this course was chosen to control risks from unstable peroxides following flooding caused by Hurricane Harvey. Over the longer term, biological treatments that result in substance detoxification can be applied.
- **Sorption and recovery.** Sorbents can be grouped into three main types: Synthetic (polyethylene and polypropylene, nylon, polyester/cotton), organic (peat moss, straw, sawdust, coconut fiber, cork, chicken feathers, ground corn cobs, wood chips, and wool), and inorganic (vermiculite, perlite, glass wool, volcanic rock). Sorbents come as both linear materials, such as pads, rolls, and boom, that can be handled as one unit, and as particulates that are spread over land and then recovered by scraping, raking, or vacuuming. Wide use of sorbents – such as on large releases – is limited by the intensive labor required and the amount of solid waste generated. In some cases, absorbed and adsorbed chemical substances may be recovered.

- **Dispersal.** In some cases, chemicals can be made non-hazardous to humans by simple dilution with water. Dispersants are chemical agents applied to the spilled material that aid this process. By promoting the formation of very small droplets; these droplets also increase the surface area available to bacteria, accelerating any biodegradation of the chemical.
- **Vapor suppression**. The release of gases or volatile liquids has the potential to generate vapor clouds that could be toxic and/or explosive. Therefore, the use of vapor suppression products for volatile substances is key for protecting workers and downwind populations. Both temporary and long-term foam-type products can quickly “knockdown” vapors and dusts. Activated carbon adsorption products can be effective for vapor control as well as for soaking up liquid. In some cases, covering the spill area with plastic may be appropriate. Modeling can help predict vapor movement and identify areas at risk; involved populations can then be advised as needed to evacuate, stay indoors, etc.

Figure 50: Damming, vacuuming, and sorption for contamination control following a surface spill

Personnel initially responding to the scene of a chemical incident need to be trained to a hazardous materials/WMD “awareness” level and if possible, to the “operations” level, as outlined by the National Fire Protection Association (NFPA), in order to rapidly assess the situation and, if possible, take actions to control the spread of contamination.[53] Having this training is especially important in the context of response to natural disasters, as the occurrence of an associated chemical incident may not be identified immediately. In an industrial or transportation accident, rapid assessment of the location of storm drains and water sources, wind direction, and gradient of the surrounding terrain can be critical for determining immediate actions for the controlling contamination spread. For example, the impact of a larger-volume incident could be minimized by actions as simple as placing drain protection covers over storm sewer inlets.

First responders may perform limited cleanup activities, provided they follow standard operating procedures and the responder has been adequately trained – in many cases to a minimum of the (HAZWOPER) Hazardous Materials Operations Level.[29] For a small release, these activities may include the application of basic containment techniques, that is, methods to restrict the material to its original container (e.g., plugging, patching, overpacking, etc.), and methods to limit the size of the contaminated area (e.g., mist knockdown/ vapor suppression, diversion, diking, booming, absorbing, fencing, and damming).

Refer To

- *NFPA 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*
- *NFPA 1072: Standard for Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Qualifications*
- OSHA 29 CFR *1910.120: Hazardous Waste Operations and Emergency Response* (HAZWOPER) standard

Properly trained responders with spill kits containing an assortment of absorbents can accelerate the attainment of response and recovery goals for minor incidents. For a small release, the use of granular absorbents, oil absorbent pads, or universal absorbent pads for non- petroleum products may be an easy way to control the spill. These products are readily available and very effective for controlling small chemical releases, provided response personnel understand standard operating procedures for their use and appropriate collection and storage methods for contaminated absorbents. Solidifiers, acid and caustic neutralizers, and activated carbon absorbents are a boon for responders. Once solidified, neutralized, or absorbed, releases substances are less hazardous and easier to handle, transport, and dispose of. Responders arriving early at the scene of transportation accidents involving a chemical release will likely have access to three main types of spill kits; utilization of specific kits depends upon the substance and volume of hazardous material released:[54]

- Universal or general-purpose spill kits contain absorbents made with activated charcoal or a similar capturing product; these kits are used to cleanup both water-based fluids and hydrocarbons.
- Oil-only spill kits are used to clean-up hydrocarbons only (motor oil, jet fuel, diesel, gasoline, hydraulic oil, etc.) and contain absorbents that repel and float on water.
- HazMat spill kits contain absorbents for fluids such as acids and solvents and will absorb hydrocarbons as well as water-based fluids.

Dedicated HazMat teams with additional containment and cleanup capabilities will augment these early responders later in the response timeline. In major jurisdictions, these teams will follow quickly on the heels of initial responding units.

A Hazardous Materials Response Team can be expected to provide the following functions (see also KPF 2, Recognize and Characterize the Incident):[28]

- Detect the presence of and identify associated chemical and physical properties of hazardous materials/weapons of mass destruction (WMD)

- Identify and establish control zones after contamination spread
- Contain and mitigate liquid and vapor leaks through interventions such as neutralization, plugging, and patching
- Use protocols to collect and label substances and evidence in preparation for transportation
- Take actions to contain the spread of contamination

Figure 51: HazMat responders with equipment

2.3. Incidents in Bodies of Water

The environmental effects of chemicals released into bodies of water (marine or freshwater) depend on several factors. Consequences will depend upon not only the chemical's toxicity and the quantity released, but also its resulting concentrations, the length of time it is maintained in the water column, and the sensitivity of the organisms in the water. Consequences will also depend upon meteorological conditions and local topography. In calm waters, the area exposed may be relatively small and expand slowly; conversely, in rivers or confined waterways, a moving plume can travel downstream quickly, and the area exposed can expand rapidly. In the open sea, tides, currents, and turbulent diffusion usually speed the dilution of released chemicals.

When released into water, chemicals may evaporate, dissolve, float, sink, react further to produce other chemicals, or a combination of these. Actions taken to control the spread of contamination should consider these behaviors.[55] For example, depending on a chemical's density, actions to stop contaminant dispersal should focus on the surface water, the water column, or the bottom water near the underlying sediment. Thus, simple initial estimations of a chemical's likely behavior and effects can be made based on the physical properties of the chemical in combination with the environmental conditions (air and water temperature, water movement, wind speed and direction).

These estimations should be used to select appropriate control actions. Response actions should be proportional to the threat posed by the volume and hazards associated with the chemicals released, realizing that some chemicals become more toxic when exposed to water.

Figure 52: Containment booms on large and small bodies of water

In water, the following contamination control techniques are commonly, and often concurrently, applied:[22,37,55,56]

- **Containment and recovery.** Buoyant chemicals often spread across the water surface, forming a slick in a manner similar to oil, although they may not be visible. Exclusion, diversion, river, and shore-sealing booming techniques are often used to contain and control chemical movement on a body of water's surface, with the aim of using skimmers and other spill response equipment (including sorbent materials) to recover/ remove the spilled material. Other techniques used to control or contain floating chemical slicks include the construction of beach berms, dikes, or dams. Chemicals that sink have the potential to contaminate the riverbed/lakebed/seabed and may persist in the sediment there, although in some cases, sinking agents may be added to contaminated water in an effort to remove the released substance from the water column. The use of dredgers or pumps/vacuums to recover sunken chemicals and contaminated sediment may be considered, although such actions will generate large quantities of potentially contaminated material for disposal. In some circumstances, in situ 'capping' of contained sediment may be an option; here, heavier, clean sediment is dumped on top of contaminated sediment.
- **Neutralization.** Chemicals that dissolve in water will form a growing plume. Some dissolved plumes may be neutralized by the application of flocculants, gelling agents, activated carbon, complexing agents, oxidizers, or reducers. Here, modeling can help predict plume movement and identify potential hazards to nearby resources such as fisheries, water intakes, and recreational areas. However, the ability to contain dissolved chemicals is limited, especially in open waters (at

sea) where there is likely to be a delay between incident and response, and large volumes of water are involved. For chemicals that float in water, in situ burning may be possible.

- **Sorption and recovery.** The spread of floating chemical slicks may be controlled with the use of passive, sorbent materials to recover/remove the spilled material. Although booms containing absorbent material are commonly used, sorbents are generally less useful in the water than on land due to their cost and the large volumes of contaminated waste that are produced and require specialized disposal.
- **Dispersal.** In some cases, treatment of floating chemicals with dispersants may be possible. This allows the chemical to break up into small droplets that can be dispersed into the water column, both diluting the chemical and promoting its biodegradation. Dispersants also make it easier for waves to break up the chemical slick, which helps prevent the slick from being driven by wind and currents toward shore and helps prevent dispersed chemical particles from re- coalescing into larger droplets that may recreate sheens. As they speed the removal of the chemical from the water, dispersants can reduce a spill's potential impact on shorelines, sensitive habitats, and wildlife on or near the sea surface. Dispersants may be effective in situations where booming and skimming may not be possible (e.g., in areas with fast currents or choppy waters).
- **Vapor suppression.** As on land, released gases or volatile liquids have the potential to generate toxic and/or explosive vapor clouds, threatening the health of nearby populations as well as responders. Again, modeling can help identify areas at risk. If possible, leaking vessels may be maneuvered so that these vapors are carried away from populations. Alternatively, knockdown of a vapor cloud with water sprays or foam to stop or deflect its movement may be possible, depending upon the reactivity of the chemical with water, and considering the concomitant generation of large volumes of contaminated water. In open environments, toxic vapors will usually disperse as a result of natural air movement, and the only feasible response action may be to monitor the cloud and its dispersion.

Response options for inland and near shore waters are wider ranging than for offshore waters due to environmental, meteorological, logistical, and cost constraints. In general, unless the spill involves oil, response options in the open sea are limited. In addition to actions taken at the release site, various actions may be taken to reduce the risks to the surrounding population and the environment. Local authorities may decide to evacuate some areas, prevent recreational activities, close beaches, or impose fishing restrictions to protect fishermen and/or consumer health.[56]

What Will You Need to Know?

☐ What are the physical properties of the chemical released?

- How does the chemical behave in or react with water?

☐ What are the relevant environmental conditions?

- Air and water temperature? Water movement? Prevailing wind speed and direction?

☐ What are the nearby water resources (fisheries, water intakes, and etc.)?

☐ Who will you contact to find out:

- How persistent the chemical is in the environment?
- With what does it react adversely (i.e., water)?
- If the chemical is susceptible to inactivation (i.e., via natural physical processes or decontamination)?
- The source of the release?
- Likely modes and areas of spread?
- If the contamination is limited to humans or if there is environmental contamination also?
- If there is environmental contamination, how will you find out the size of the affected area?

Action Item

Establish protocols to monitor and control agent fate and transport after the initial incident by:

- Utilizing established procedures and considering equipment already in the jurisdiction
- Employing protocols for establishing and controlling restricted areas (for hazardous materials and non-hazardous materials events)
- Developing protocols and agreements to rapidly gain access to additional workers and equipment in an incident

2.4. Oil Release Incidents

The most common HazMat incidents in the U.S. are spills involving petroleum products. Activities in response to oil releases on land differ little from those in response to other chemical releases on land. However, when released in water, oil incidents represent a special case of chemical incidents. The following are common actions taken to control the spread of oil contamination following releases offshore or in bodies of water:[52]

- **Booming.** Boom is typically the first mechanical response equipment taken to an oil spill site, where it is used to (1) contain slicks for removal by skimmers or burning, (2) deflect or divert slicks towards a collection area or away from sensitive resources, (3) exclude slicks from selected areas and protect sensitive shorelines and amenities, and (4) ensnare oil by the addition of sorbent material.
- **Sorbent use.** Sorbents are used to recover small amounts of oil. In general, use of sorbents is only appropriate during the final stages of a cleanup or to remove thin films of oil. Sorbents can also be used to protect and/or clean environmentally sensitive areas where the use of other methods is restricted. Solidifiers react with oil to bind it into a cohesive mass, immobilizing it and reducing its ability to spread; solidified masses may float until removed from the water. Because solidifiers are applied as powders, granular mixes, or gels, they are impractical for use on large spills.

- **In situ burning.** In situ burning removes oil from a surface by combustion; burning may provide the only means of quickly and safely eliminating large amounts of oil in situations where mechanical cleanup methods would be destructive or impossible to perform. Burning small spills is routinely conducted (1) to quickly remove oil, so that it does not spread over larger areas or into sensitive areas, (2) to reduce the generation of oily wastes, especially where transportation or disposal options are limited, and (3) as a final removal technique, when other methods lose effectiveness or are too intrusive.
- **Dispersant application.** Dispersants reduce the interfacial tension between oil and water, allowing the oil to break up into small droplets that can be dispersed into the water column and that promote biodegradation Many international agencies and regulatory bodies view dispersants as the most practical response option for offshore oil spills as in many cases their use results in the lowest environmental impact and they can be used in situations where mechanical means such as booming and skimming cannot. However, over time, an oil slick "weathers" and becomes more viscous, making chemical dispersion more difficult.
- **Shoreline protections.** Shoreline protection response strategies include: (1) natural recovery, in which a site is allowed to recover without intervention; (2) physical treatments, whereby oil is removed manually or by water spray, vacuums, or scraping machinery; (3) chemical treatments, in which EPA-approved products are used to increase the efficiency of water washing; and (4) bioremediation, which is typically used as a final treatment step after completing other treatments. However, every reasonable effort should be made to prevent oil from reaching the shore in order to reduce environmental impacts, the duration of cleanup operations, and generated wastes, as shoreline cleanup operations are much more labor intensive than water-based operations.

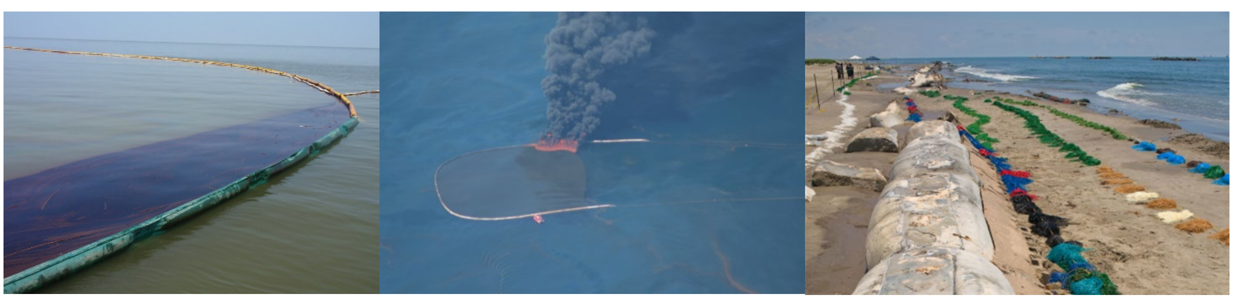


Figure 53: Containment measures following the Deepwater Horizon Oil Spill, 2010

3. Human, Animal, and Equipment Decontamination

While environmental remediation and containment are essential to controlling the spread of contamination, emergency management protocols for controlling chemical spread should also include plans for decontaminating survivors and their pets prior to their transport and/or entry into medical facilities, and decontaminating first responders, their vehicles, and their equipment. The implementation of such protocols will significantly reduce the risk of contamination spread and re-contamination of areas that have been decontaminated.

Although not all individuals exposed during a chemical incident (survivors) may be contaminated, and not all individuals that experience health consequences as a result of a chemical incident may be contaminated, in general, decontamination has the potential to reduce health consequences for incident survivors by reducing their exposure time. In a sense, decontamination of survivors is a type of treatment. Moreover, decontamination of survivors (and medical equipment) before their transport to a care facility avoids downstream contamination of responders and healthcare personnel. For this reason, a major goal of the initial response to a chemical incident that involves human or animal exposures is the decontamination of contaminated individuals.[37,57] For a discussion of sources of primary and secondary contamination for survivors and responders, see below.

Primary and Secondary Contamination[58]

Primary contamination is the contamination of persons or equipment as a result of direct contact with the initial chemical release source.

Secondary contamination refers to the contamination of healthcare or other responding personnel or equipment as a result of contact with a person (survivor/patient) or equipment that is covered with adherent solids or liquids that have been removed from the release source. Secondary exposures may arise from either:

Direct contact hazards: Contact exposures occur via the touching of surfaces (clothing, floors, walls, seats, turnstiles, handrails, etc.) on which the substance is present. The substance may be present on a surface due to a direct spill, its deposition onto the surface from a release that created airborne liquid droplets, or contact with other contaminated surfaces. Contact exposures followed by human movement can lead to contaminant spread; contact exposures can also lead to responder exposure/ contamination while treating patients prior to their decontamination. Certain substances (especially low volatility chemicals such as the nerve agent VX) may remain on surfaces for a long time, even after an initial decontamination, and thus represent long-term exposure risks.

Airborne hazards: Chemicals can evaporate from the skin and clothing of exposed individuals that came into contact with liquids. Again, this can lead to responder exposure/contamination while treating patients prior to their decontamination. Greater hazards exist in smaller and/or poorly ventilated spaces. To reduce evaporation hazards, contaminated clothing should be removed as quickly as possible and placed in sealed containers for disposal.

Action Item

Planners should familiarize themselves with state, regional, and local plans for decontaminating victims, first responders, and responder vehicles and equipment.

3.1. Equipment Decontamination

As with environmental control strategies, the strategies available for decontaminating equipment are highly chemical-specific and situation-dependent. Effective decontamination methods differ based on chemical type, contamination route, and type of equipment/surface. Decontamination approaches include:[59]

- Physical removal of gross and residual contamination to a relatively reasonable level on contaminated surfaces in accordance with State and Federal guidance
- Inactivation of contaminants by chemical detoxification or disinfection/ sterilization
- A combination of both physical and chemical means

Physical contaminant removal. In many cases, gross contamination can be removed by dislodging/displacing, rinsing, or wiping off, and/or evaporation. Contaminants that can be removed by physical means include:

- *Loose contaminants* such as dusts and vapors. These may cling to equipment and responders or become trapped in fabrics. They can be removed with water or a liquid rinse.
- *Adhering contaminants* such as glues, cements, resins, and muds. These can be removed by scraping, brushing, and wiping; removal may be enhanced via solidifying or freezing (e.g., using dry ice or ice water), adsorption or absorption (e.g., with powdered lime or kitty litter), or melting.
- *Volatile liquids*. These can be removed by evaporation followed by a water rinse; evaporation may be enhanced by using steam jets. Here, care must be taken to prevent responder inhalation of vaporized chemicals.

Chemical contaminant detoxification. Inactivation/detoxification can be achieved by wash/rinse processes using cleaning solutions that utilize one or more of the following approaches:

- *Rinsing*. Rinsing removes contaminants through dilution and solubilization and may follow dissolving and surfactant treatments.
- *Surfactants*. Surfactants augment physical cleaning methods by reducing adhesion forces between contaminants and the surface being cleaned, and by preventing redeposit of the contaminants. Household detergents are common surfactants. Some detergents can be used with organic solvents to improve the dissolving and dispersal of contaminants into the solvent.
- *Contaminant dissolution*. Surface contaminants can be chemically removed from equipment by dissolving them in a solvent. The solvent must be chemically compatible with the equipment being cleaned, and care must be taken in selecting, using, and disposing of organic solvents that may be flammable or themselves potentially toxic.
- *Solidification*. Solidifying liquid or gel contaminants can enhance their physical removal. Mechanisms of solidification are: (1) moisture removal through the use of absorbents such as clay or powdered lime; (2) chemical reactions via polymerization catalysts and chemical reagents; and (3) freezing using ice water.

Decontamination methods vary in their effectiveness for removing different substances. The chosen decontamination method should be safe, effective, and compatible with the chemical released.[59]

Potential safety risks arise from methods that are chemically incompatible with the substance being removed (i.e., a decontamination reagent may react with the contaminant to produce an explosion, heat, or toxic products) or with the cloth or equipment being decontaminated (e.g., some organic solvents can permeate and/or degrade protective clothing), or that may pose a direct health hazard to workers (e.g., vapors from chemical decontamination solutions may be hazardous if inhaled, or they may be flammable). Factors such as cost, availability, and ease of implementation will also influence the selection of a decontamination method. Information provided by a RP via EPCRA-mandated notifications should indicate safe and efficient decontamination strategies.

While surface contaminants may be easy to detect and remove, contaminants that have permeated a material are often difficult or impossible to detect and remove, and may cause unexpected exposures later in time.

The effectiveness of any method should be assessed at the beginning of a decontamination program and continue periodically throughout the program. If contaminated materials are not being removed or are penetrating protective clothing, the decontamination program must be revised.

Action Item

- Research decontamination procedures and resource needs for local risk chemicals
- Establish protocols and procedures for decontamination of vehicles, equipment, and buildings

3.2. Human Decontamination

The extent to which a survivor requires decontamination depends upon the contaminant, its characteristics, and the conditions of the release. For some survivors, emergency decontamination may be an essential part of life-saving first aid. For others, decontamination may aggravate injuries or delay life- saving treatment. The decision whether or not to decontaminate a survivor is based on the type and severity of the illness or injury and the nature of the contaminant. If decontamination does not interfere with essential treatment, it should be performed as quickly as possible, as the most important and effective chemical decontamination procedures are those done within minutes. Moreover, decontamination reduces the dose received by the survivor, so rapid decontamination could be essential for limiting harm from the exposure itself.[59] The often cited difference in the toxicity of some nerve agents (sarin vs VX, for example) is largely due to the length of time that the agent stays on the skin before evaporating, demonstrating how rapid decontamination can mitigate risks of exposure.

Decontamination may be an essential part of life-saving first aid.

Figure 54: Practicing survivor decontamination during a chemical incident exercise

Within EPCRA-mandated accidental release notifications and follow-up information, the RP/facility must include information describing appropriate decontamination procedures for exposed individuals. In the absence of RP- provided chemical-specific decontamination advice or available safety data sheet (SDS), the local poison control center or the chemical manufacturer should be contacted to determine appropriate decontamination procedures. As a general rule, guidance from the HHS Office of the Assistant Secretary for Preparedness and Response (ASPR) for survivor decontamination should be followed.

The Primary Response Incident Scene Management (PRISM) guidance emphasizes the need for the following four actions to be performed as soon as practically possible:[57]

- Evacuation – Immediate movement upwind from hazardous areas
- Disrobe – Safe removal of contaminated clothing (no form of decontamination should be undertaken prior to disrobing; disrobing itself will remove the majority of the contaminant)
- Decontamination – Removal of contamination from hair and skin (and wounds) via one (or all) of three forms:
  - Emergency decontamination by any available means, both “dry” absorbent (preferred) and “wet” (when the contaminant is caustic or particulate)
  - Gross decontamination by passing of patients through a high volume of low- pressure water mist, or by spraying patients with hosepipes using a fogging nozzle
  - Technical decontamination requiring the use of specialist decontamination units on-site or at a hospital
- Active drying – Drying the skin after any form of wet decontamination to assist contaminant removal

Figure 55: Practicing survivor decontamination using a water- spraying system during a chemical decontamination exercise

Within EPCRA-mandated accidental release notifications and follow-up information, the RP/facility must include information describing appropriate decontamination procedures for exposed individuals. In the absence of RP- provided chemical-specific decontamination advice or available safety data sheet (SDS), the local poison control center or the chemical manufacturer should be contacted to determine appropriate decontamination procedures. As a general rule, guidance from the HHS Office of the Assistant Secretary for Preparedness and Response (ASPR) for survivor decontamination should be followed.

Wet and/or technical decontamination will not be needed for all chemical incidents as highly volatile chemicals will evaporate. The Algorithm Suggesting Proportionate Incident Response Engagement (ASPIRE) tool, available on the National Library of Medicine's CHEMM system, provides estimates of remaining contamination post- exposure that can be used to determine whether wet and/or technical decontamination is necessary.

First responders (wearing appropriate PPE) should be prepared to assist individuals in performing the four decontamination actions described above, depending upon the needs/condition of the survivors, including non-ambulatory and disabled individuals, the elderly, unaccompanied minors, etc. In any case, clear communication with survivors and attention to patient privacy will be key to decontamination procedural efficiency and compliance, especially in mass events.

Planners should note the need for supplies such as absorbent materials, towels, bags for personal items, and waste receptacles, in additional to responder staffing and PPE needs. Contaminated clothing and equipment should be stored in a controlled area (warm zone, see below) until cleanup procedures can be initiated. All personnel, clothing, and equipment leaving the contaminated area must be decontaminated. If protective clothing and equipment cannot be decontaminated, they must be properly disposed of.[59]

Providing accurate and timely information to health care providers is critical to their ability to provide appropriate care to survivors. Ideally, local/regional emergency department staff will receive advanced notification about the release incident before any survivors arrive at the hospital, allowing them maximum event "ramp- up" time.[25,59] As noted in the Prologue, advanced notification can give medical personnel valuable minutes to prepare for the arrival of large numbers of patients and review information that might allow for a more rapid diagnosis or more effective treatment, thus potentially helping save lives (refer also to KPF 3, Communicate with External Partners and the Public). However, such advance notification may not be possible if the incident has not been identified as involving a chemical release.

Hospitals should also have a pre-established decontamination protocol in place for those patients that self-present at the hospital and were not decontaminated at the scene, and for those patients for whom the field decontamination was insufficient. Patients requiring skin decontamination should not be allowed to enter the hospital. Additional medical treatment needs are addressed in KPF 6, Augment Provision of Health and Medical Services to the Affected Population.

Refer To

- *Primary Response Incident Scene Management (PRISM): Guidance for the Operational Response to Chemical Incidents*. *Volume 1: Strategic Guidance for Mass Casualty Disrobe and Decontamination* for technical descriptions of decontamination procedures.
- *Patient Decontamination in a Mass Chemical Exposure Incident: National Planning Guidance for Communities* for guidance on decontamination practices at different stages of response.
- *ESF #10 — Oil and Hazardous Materials Response Annex*

Action Item

Develop a plan for assessing the nature and extent of infrastructure contamination and for cleaning up and/or decontaminating as needed.

Establish protocols and procedures for human decontamination by:

- Ensuring procedures will meet the needs of ambulatory and non-ambulatory individuals, those with disabilities, and those with other needs for assistance
- Establishing protocols for rapid control of hospital entry
- Developing decontamination processes for entry and exit of restricted areas
- Ensuring local medical facilities have decontamination protocols in place

3.3. Animal Decontamination

A chemical incident could harm livestock, companion animals (pets) and service animals. Removing external contamination is the first priority so that an animal does not contaminate itself, other animals, humans, or the environment. Best practices for animal decontamination have been outlined by the National Alliance of State Animal and Agricultural Emergency Programs (NASAAEP). Where possible, the veterinary community may employ isolation and/or decontamination measures similar to those used in human populations. In many cases, destruction and safe disposal of contaminated livestock may be economically preferable to decontamination and serve to reassure consumers that contaminated products would not enter the food supply.

Considerations for scalability should be included in planning as catastrophic scenarios could necessitate the decontamination of hundreds to thousands of pets and other animals.

Decontamination of wildlife is especially challenging and is likely to involve interagency cooperation and trained professionals. Wildlife cleanup is expensive, time-consuming, and often unsuccessful. Many species are too difficult to capture, and for some, the stress of captivity during decontamination may itself be harmful.

Figure 56: Decontamination of a family pet following a mercury spill

Coordination Opportunity

Coordination with the veterinary community will be needed to plan for and implement appropriate containment and decontamination procedures for companion animals, livestock, and wildlife.

Refer To

- The National Alliance of State Animal and Agricultural Emergency Programs (NASAAEP)'s *Emergency Animal Decontamination Best Practices* (September 2014) for practical information regarding planning, training, and exercising for emergency animal decontamination.
- HHS Assistant Secretary for Preparedness and Response (ASPR)'s collection of information on Veterinary Issues that addresses disaster-related animal issues, including animal decontamination
- *ESF # 11 – Agriculture and Natural Resources Annex* will coordinate with state, tribal, territorial, and local governments to provide veterinary emergency first aid and care.

What Will You Need to Know?

☐ Can additional exposures result from contact with contaminated individuals?

- If yes, should decontamination be part of the planning process for shelters and community reception centers?
- How is that decision made?
- What is the decontamination process?
- Who participates in the decontamination process?
- Who will you contact for this information?

☐ How is chemical contamination passed along?

- Through direct contact with contaminated fomites, individuals and/or animals?
- Via ingestion or inhalation?

☐ What are the decontamination resources (equipment, personnel, etc.) in your region?

- What are their capabilities and capacities?
- Who will you contact for decontamination resources?

3.4. Site Localization of Decontamination

Appropriate scene management is fundamental to ensuring the safety of both responders and the public in a chemical release incident, and for reducing the potential for contamination spread, especially in emergency situations.

First responders should have emergency guidance available such as that provided in the Department of Transportation (DoT) Emergency Response Guidebook (ERG), as well as the chemical hazard information provided to LEPCs and TEPCs under EPCRA to minimize their risks when responding to an emergency.

Hazardous Materials Response Team personnel are trained to operate safely within the release area and respond to control the release, contain the incident, determine additional courses of action, initiate survivor rescue, and conduct initial cleanup or neutralization of the incident site. Such teams will establish three control zones at the scene of the chemical release: the hot zone, the warm zone, and the cold zone.[25,59,60] These zones will both help protect personnel from contamination and reduce its accidental spread by delineating where on the site different types of operations will occur and controlling the flow of personnel between them. Delineation of these three zones should be based on sampling and monitoring results and on an evaluation of potential routes of contaminant dispersion in the event of a release.

- The **hot zone** (red zone, exclusion zone) is the area immediately surrounding the incident site in which primary contamination may occur. The zone extends far enough to prevent the primary contamination of persons and equipment/ materials outside the zone. In general, evacuation – but not decontamination or patient care – is carried out in this zone (with certain exceptions). The primary activities performed in the hot zone are site characterization and cleanup work, and some monitoring activities. Access Control Points should be established at the periphery of the hot zone to regulate the flow of personnel and equipment between the hot and warm zones.
- The **warm zone** (yellow zone, contamination reduction zone) surrounds the hot zone and contains the area where survivors and responding team members and their equipment are decontaminated. Survivor treatment may be initiated here. The warm zone is designed to reduce the probability that the cold zone will become contaminated by putting distance between the hot and cold zones. Further, the warm zone controls the transfer of workers and equipment into clean areas, again via Access Control Points; any potentially contaminated clothing, equipment, or sample must remain in the warm zone until decontaminated. The decontamination plan should be developed (as part of the Site Safety Plan) and set up before any personnel or equipment enter areas where the potential for exposure to contamination exists; it should be revised if PPE, equipment, or site conditions change, or if site hazards are reassessed based on new information.
- The **cold zone** (green zone, support zone) is the uncontaminated area beyond the warm zone in which resources are assembled to support the response. No protective gear should be needed within this zone, and any function that need not or cannot be performed in a hazardous or potentially hazardous area is performed here. The incident command center is usually in the cold zone. In addition, there is greater ability to provide patient care here.

Before any responders enter hot zones, emergency medical responders trained in the recognition of signs and symptoms caused by hazardous materials intoxications and the delivery of antidotes/medical countermeasures should be on-scene and with appropriate resuscitative equipment/MCMs.

Moreover, responders must have personal protective clothing and equipment (PPE) that shields or isolates them from the chemical, physical, and biological hazards that may be encountered, minimizing their exposures. The type of PPE required will depend on the characteristics and amount of the chemical agent involved (e.g., volatility, persistence, inhalational risk, etc.), as different types of PPE provide different levels of respiratory and skin protection. Healthcare professionals, first response and volunteer personnel, veterinary personnel, and environmental sampling personnel may all be issued PPE during a chemical incident.

OSHA Levels of PPE[61]

- Level A (the highest level) is a self-contained breathing apparatus (SCBA) worn under a vapor-protective, fully encapsulated, airtight, chemical- resistant suit.
- Level B is a positive-pressure supplied- air respirator with an escape SCBA worn under a hooded, splash- protective, chemical-resistant suit.
- Level C is an air- purifying respirator worn with a hooded, splash- protective, chemical-resistant suit.
- Level D (the lowest level) is a regular work uniform that offers no protection

Action Item

Create a site safety, security, protection, and law enforcement plan that includes requirements for and sources of protective equipment for responders.

What Will You Need to Know?

- ☐ What types of PPE are necessary for local chemical hazards?
- ☐ Where can PPE be obtained?
- ☐ Who should be issued PPE?
- ☐ How will PPE needs change throughout response and recovery activities?
- ☐ What will you do if there is a shortage of needed PPE?

Refer To

- *ESF #13— Public Safety and Security Annex*
- EPA *Standard Operating Safety Guidelines* (June 1992)
- OSHA 29 *CFR 1910.120: Hazardous Waste Operations and Emergency Response* (HAZWOPER) standard
- *NFPA 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*

Coordination Opportunity

- Across the first responder community, discuss safe roles for non-HazMat first responders at a chemical release site. What is their role in establishing or maintaining buffer zones?
- Strong cooperative ties between planners and local chemical facilities will help ensure that communities receive timely updates on facility chemical holdings. As a result, communities will have prior knowledge of and can establish effective containment and decontamination procedures and resource needs. Further, contacts can be made with the range of experts that local situations might require, such as the Poison Control Center, medical toxicologists, chemical industry members, and chemical warfare agent specialists, facilitating access to critical expertise at the earliest possible moment. Local chemical industry specialists will generally have expertise in their product's chemical behavior, best methods for its containment and cleanup, and potential hazards to specific methods routinely used by fire or environmental responders. Industry may also provide access to medical countermeasures stockpiled on their premises.

4. Other Protective Actions

Additional protective actions such as evacuation or shelter-in-place, travel and site access control, facility closure, food recall, and goods/materials isolation may serve as stopgap measures to control contaminant spread. Such measures bridge the time between recognition of the incident and containment of the source of the release or decontamination of the area. When taken shortly after recognition of the chemical incident, these actions can be crucial for slowing the spread of contamination in the environment and reducing exposures in populations. In the context of the protection of human and animal health, many of these actions may be referred to as non-pharmaceutical interventions (NPI).

Since exposure doses generally determine the severity of injury, NPI are critical to minimizing the impact of a chemical release because they:

- Limit number of people exposed to the chemical, thus minimizing the number of people injured
- Lessen the dose received by those that are exposed, thus reducing their severity of injury

Successful NPI, then, will likely also reduce the need for pharmaceutical interventions and hospital resources (e.g., emergency department (ED) and/or intensive care unit (ICU) beds). Since pharmaceuticals to treat exposure do not exist for most chemicals, NPI may serve as the predominant protective interventions for most chemical incidents involving human or animal exposures. For the minority of chemical exposures for which a pharmaceutical treatment/antidote exists, NPI also bridge the time until such pharmaceuticals arrive to the incident scene/site (see also KPF 6, Augment Provision of Health and Medical Services to the Affected Population).

4.1. Evacuation/Sheltering

Depending on the nature of the chemical incident, people in the affected area may need to evacuate or shelter-in-place at a specific location to prevent them from being exposed and/or contaminated. A successful evacuation removes people from the affected area and avoids exposure to the released chemical. (An example is the evacuation of area populations following a chlorine release described in the Prologue.[12]) During shelter-in-place, people seek shelter inside a building and remain inside until the danger passes. Making the decision to recommend sheltering or evacuation is one of the most important and potentially consequential decisions facing local emergency officials following a toxic chemical release. The decision is often not easy to make, even when relevant information is provided by RPs, and generally must be made quickly, even when all relevant information is not available. The decision to have a population evacuate vs. shelter-in-place revolves around two key questions:[25,62]

- Will shelter-in-place provide adequate protection, preventing people from receiving a harmful exposure to the chemical?
- Is there time to evacuate before the chemical plume reaches the area?

The answers to these questions depend upon a number of factors that contribute to the effectiveness of either protective action, including:

- The identity and amount of the chemical released, and its degree of health hazard and containment
- The chemical's location and rate of movement
- Locations and populations of projected areas affected at time of day of release
- The time until the hazard is projected to reach and clear each affected area
- How long the implementation of protective actions will take, including evacuation and/or shelter-in-place, and including considerations for family reunification (e.g., if children are in school or daycare, etc.)
- The availability of and degree of protection offered by local housing and buildings (i.e., their ability to be "sealed" from outside air)
- Traffic, and inclement weather or road closures that may impede evacuation
- Current or impending weather conditions that might affect chemical movement or the safety of sheltering-in-place

Unfortunately, a simple technical decision-making method for choosing protective actions does not exist as the circumstances and the relative importance of the factors listed above will vary with each release scenario. Further, information critical to decision-making is likely to be uncertain or incomplete, particularly early on in the response. In general, sheltering-in- place is best used when evacuating the public would cause greater risk to them than staying where they are, or when an evacuation cannot be performed due to time or other constraints. However, sheltering can have negative consequences if shelters are leaky, people are not advised when it is safe to leave the shelter, or the release continues for an extended period of time. Evacuation may be preferable when the substance released includes flammable vapors, the substance will linger for a long time in an area, or buildings cannot be closed tightly enough to provide safe shelter. Evacuation can have negative consequences if the population of the affected area is caught outdoors or in their vehicles when contamination enters the area.

For any particular release, a combined response may be called for, with sheltering-in-place recommended for areas close to the release and in the possible path of contamination, and evacuation recommended for areas that have more time before possible exposure to the chemical. Protective action advice may differ for urban vs. rural areas. While urban areas are likely to have many more people in the area at risk, due to their high population densities and the short response times often required, their rapid evacuation may be impractical. However, in an urban area, buildings can provide considerable protection against an outdoor cloud of toxic chemicals, particularly for reactive chemicals like chlorine. Thus, a temporary shelter-in- place may be the safest course of action for a densely packed public, especially in incidents in which there are only a few minutes to protect people. In contrast, rural areas are likely to have relatively few people within a risk area, so evacuations can proceed more smoothly.

Figure 57: Effective evacuations require pre-planning

Overall, jurisdictions should consider shelter-in-place as the first/default option, when feasible, as it has reduced costs, resource requirements, and negative impacts than evacuation. Yet if extended (multi-hour) sheltering is being considered, authorities should work to ensure sheltered individuals have adequate food, water, sanitation, medical care, and protection from the elements (see also KPF 5, Augment Provision of Mass Care and Human Services to the Affected Population).[63]

Evacuations represent a sweeping course of action, and decisions to evacuate cannot be made lightly; evacuations cannot be carried out effectively without preplanning. Plans should be developed that clearly identify under what circumstances evacuation would be appropriate and necessary. Evacuation plans should:

- Identify how instructions will be effectively communicated to the public
- Identify how people and animals will be moved (i.e., by city buses, police cars, private vehicles, other)
- Make provisions for redirection of traffic
- Identify the location to which students will be moved and how parents will be notified
- Include plans for evacuating hospitals, nursing homes, and homes for the physically or mentally disabled

Making the decision to recommend sheltering or evacuation is not always easy, even when relevant information is available.

Implementation of evacuation and shelter-in-place decisions for small-scale incidents are typically handled at the lowest possible jurisdictional level by local incident commanders or public safety officials (e.g., fire chief, police chief, public health official). For community-level or larger-scale events affecting multiple jurisdictions, higher-level authorities such as those exercised by elected officials at the local or state level (e.g., mayor, county executive, judge, governor) are often necessary to issue evacuation orders.

Coordination Opportunity

Evacuation should occur in coordination with the appropriate local, state and federal groups, such as the Federal Emergency Management Agency, Federal Highway Administration, state Department of Transportation, the Civil Defense, county sheriff, local radio and television stations, municipal transportation systems, National Guard, and police. Local/private building and infrastructure operators should also be included in evacuation planning and execution, for example, office building, hotel, and stadium operators. Plans and procedures should be reviewed regularly by all involved.

Refer To

- *Planning Protective Action Decision-Making: Evacuate or Shelter-In-Place?* for a discussion of evacuation vs. shelter-in-place decision-making.
- *Planning Considerations: Evacuation and Shelter-in-Place, Guidance for State, Local, Tribal, and Territorial Partners* (July 2019) for a discussion of tailoring protective actions to the chemical involved and a community's demographics, location, infrastructure, and resources.
- *Mass Evacuation Incident Annex* to the *National Response Framework*

What Will You Need to Know?

- ☐ How will evacuation/sheltering decisions be made?
  - Where will they get the information they need to make the decision?
- ☐ Which agency(ies) has authority to order evacuation of the community?
- ☐ How will an evacuation be carried out?
- ☐ How will the public be notified?
- ☐ Where are the emergency evacuation routes in your region?
  - What are the route capacities from these areas?
  - Are they well marked?
- ☐ How will you evacuate people with their service animals and/or pets?
- ☐ Where are the evacuation centers/facilities in your region?
  - What are their capacities?
- ☐ Where can evacuees be sheltered along with their service and/or companion animals?
- ☐ How can you ensure sheltered individuals have adequate food, water, sanitation, medical care, and protection from the elements?

Action Item

- Develop a coordinated, local decision-making process for selecting and implementing protective actions that can be rapidly implemented on a 24-hour basis
- Address the selection and implementation of site access and traffic control points; criteria for combining evacuation and shelter-in-place as public protection measures; and protective measures for vulnerable populations and those with disabilities
- Identify facilities and develop procedures for housing persons requiring evacuation or temporary relocation

4.2. Site Security, Site Access, and Travel Control

To prevent the spread of contamination and minimize the number of additional casualties resulting from either the initial release or lingering hazards, site access for emergency response personnel may need to be limited, and the site and surrounding areas may need to be isolated from the public and the media.

Site security is necessary to:

- Prevent the exposure of unauthorized, unprotected people to site hazards

- Prevent theft or vandalism
- Avoid interference with safe working procedures
- Protect a potential crime scene including evidence of criminal activity

When defining areas for site access control, responders should realize that both the accident site and downwind/downslope regions may remain hazardous for some time (note that downwind and downslope regions may be in different directions). Unprotected individuals, such as crowds drawn to an accident site, should be prevented from entering these regions.

Law enforcement personnel are essential for quickly establishing and controlling a perimeter to limit entry to a potentially contaminated area and for shutting down highways that may be in the path of a large toxic plume. Travel and site access limitations must be communicated to the public, especially if road closures must occur at the same time an evacuation has been ordered.

4.3. Facility Closure

Depending on the nature of the chemical incident, facilities such as manufacturing plants, agricultural facilities, transit systems, and/or other commercial or public entities may be closed to prevent exposure and reduce the distribution of contaminated materials. Facility closures are important when work is being done to control a crime scene or prevent evidence removal, destruction, or decontamination.

If health effects are immediate, patrons and employees evacuated from impacted facilities/venues will need to be triaged and treated (see also KPF 6, Augment Provision of Health and Medical Services to the Affected Population), and if necessary, interviewed by law enforcement officials. This interview process may be instrumental in the identification of previously unknown contaminated areas, prevention of secondary attacks, and/or the immediate capture of the perpetrator(s). Nearby, non-impacted facility/venue evacuations can be handled similarly to bomb threats or other police actions.

If health effects are delayed (and the incident is not otherwise recognized), exposed individuals likely will disperse throughout the city, region, state, country, and even internationally, which will likely result in people becoming symptomatic at locations far removed from the release site. This movement of survivors could complicate the identification of the incident location and the chemical involved and could result in ongoing exposures.

Water systems. Utility level water sources often can shut off their systems, or portions thereof, immediately after notification of a problem to help contain the spread of contamination. In fact, “do not use” (DNU) order notices and alternate water supplies are a core part of local emergency planning in most areas of the U.S., allowing for the protection of public safety while characterizing the extent of a chemical release threat. As discussed in the Prologue, a DNU was put in place around Charleston, WV, to protect the public when the water system there was contaminated by a leaked chemical.[4]

Figure 58: West Virginia National Guard responding to the Elk River chemical spill

Indoor public venues.[64] In most situations, measures should be taken to contain a release within an indoor public venue by shutting down ventilation systems, because:

- *Venting moves contamination into the surrounding streets*. While ventilation removes contamination from the venue itself, it transfers the contamination to the streets nearby, potentially exposing more people to the hazard. Even with a ventilation shutdown, responders should expect some residual contamination spread.
- *Venting moves contamination through the venue*. By pulling contaminated air throughout the venue, more individuals could be exposed.
- *"Late" in the event, venting has limited effectiveness in reducing exposures*. For many scenarios, by the time an incident is identified, most onsite exposures have already occurred. If the venue is closed and unexposed patrons are prevented from entering contaminated areas, ventilation will provide limited benefit.

Transit (subway) systems.[64] The consequences of a chemical release within a transit system may be widespread. Contamination spreads quickly in a subway system as trains move through contaminated station(s). Every train passing through the area acts as a moving source as it continues, such that several stations can become affected within minutes of release. Train and passenger motion can also spread contamination between subway lines at crossover stations. In fact, unless it is shutdown early in the event, the system will efficiently spread contamination and exposed individuals throughout the city; responders should expect impacts at many, widely separated stations. For example, the delayed shutdown of the Tokyo subway during the 1995 sarin gas attack resulted in the contamination of hundreds of people and fifteen stations along multiple train lines.

Since the amount of time any single passenger spends in a subway transit system is often relatively short (15-60 min), many exposures can be avoided by preventing people from entering the system altogether, or even by preventing a single train from entering a contaminated area. In fact, subway events should trigger a system-wide shut-down, including evacuating all patrons and stopping all trains. After system evacuation, station(s) must be secured to protect unaware individuals from entering the hazard area and becoming exposed and/or contaminated.

For the same reasons as with other high-traffic indoor public venues, shutting off active ventilation following a chemical release in subway systems is recommended. Such action helps to avoid spreading contamination further throughout the system and into the streets above, thus containing the substance and helping to prevent additional exposures. Exceptions to this can be made in some situations; for example, the Tokyo subway system's powerful air exchange system is credited with helping to reduce the number of casualties caused by the 1995 sarin gas attack.[65]

Figure 59: Transit (subway) system

Usually, transit system contamination should trigger a shut-down of ventilation systems to prevent contamination of above-ground areas. However, venting can be a powerful mitigation tool when the release is rapidly recognized and known to be small, and/or venting can be done with minimal above-ground exposures. This tool should only be applied to a subset of scenarios identified through detailed planning and coupled with an active, real-time field detection system and a thorough playbook of ventilation options.

If contamination of a subway system is suspected in a jurisdiction lacking established sheltering procedures, the community should consider sheltering above ground populations within ½ mile of stations suspected of significant contamination.

Coordination Opportunity

Law enforcement understand the need for site/hazard mitigation and life-saving actions just as firefighters and EMS understand the need for crime scene preservation. Often these activities are conducted simultaneously and collectively. Integration of the various response agencies during the planning process can alleviate some of the concerns and may mediate perceived (or actual) conflicts.

4.4. Food Recall

Prevention of exposures to contaminated foods (and the resultant casualties) requires rapid action by both responders and the general public. In response to a food-related incident, response operations will place immediate priority on preventing further exposure by identifying the causative adulterant and the affected food product (see below), removing unpurchased product from market shelves, and communicating with the public to avoid consumption of already purchased product. When appropriately warned, the public is less likely to consume contaminated food products. The number of exposures that occur depend then on:

- How quickly the event is recognized
- How quickly retailers remove products from shelves
- How quickly the warning to stop consumption is issued to the public
- The warning method used (discussed further in KPF 3, Communicate with External Partners and the Public)
- The product's shelf life and typical distribution and consumption periods
- Whether a common ingredient used in many products has been contaminated (this increases the opportunity for widespread effects over a longer period of time)

When a chemical incident involves a contaminated food product, the FDA will recall potentially contaminated/dangerous food products to prevent further spread of contamination and human or animal exposures. A coordinated, well-executed response to a food contamination event can greatly limit the number of people consuming the contaminated food and the resulting casualties. The media attention that will naturally follow from unusually large numbers of affected people will be a boon in this situation, as information regarding food recalls will be disseminated widely in near real-time. However, even shorter shelf-life foods, if they can be frozen and consumed later rather than eaten immediately, can lead to illnesses reported over a longer period of time if individuals do not heed public warning messages. As an example, contaminated food-related illness was noted 49 days after product recall in a 2003 case of nicotine-contaminated ground beef, as the individual had finally consumed frozen product.[66]

4.5. Isolation of Goods and Materials

Beyond limiting the potential for additional spread of contamination via transportation of goods, the isolation of contaminated (and potentially contaminated) products (e.g., import/export restrictions) will also help reinforce public messages around the health risks and safety of regionally-produced goods, both immediately and long-term after the incident. These messages should target both the domestic and international communities and influence the area's overall achievement of economic recovery outcomes.

Action Item

Consider the potential consequences of NPI implementation including civil rights and civil liberties, and financial impacts.

What Will You Need to Know?

- ☐ Who has the authority to execute NPI? Laws may vary by state.
- ▪ For example, who has the authority to order evacuations?
- ☐ Has law enforcement been trained in NPI procedures?
- ☐ How will you know if there will be civil rights, civil liberty, and/or financial consequences to NPI implementation?

KPF 5 Augment Provision of Mass Care and Human Services to Affected Population

This operational area includes planning for mass care services, housing, and health and social services following a mass casualty chemical incident. Unique considerations for emergency assistance will arise during a chemical incident due to demands and constraints posed by issues such as contamination spread and public fear.

1. Provide Support to Affected Populations

Mass care services provide life-sustaining and human services to disaster- affected populations, including feeding operations, emergency first aid, distribution of emergency items, and family reunification. Additional resources and services may need to be mobilized to support individuals with disabilities, limited mobility, limited English proficiency, children, household pets, and service and assistance animals. During mass evacuations, mass care services may also support the displaced population via sheltering. Human services include disaster assistance programs that help disaster survivors recover/replace lost personal property, obtain disaster loans, food stamps, crisis counseling, disaster unemployment, disaster legal services, etc. Timely and adequate provision of mass care and human services to the affected population is a critical first step toward attaining incident recovery outcomes.

Objective for Emergency Mass Care: Provide for basic survival needs including food, water, emergency supplies, and a safe, sanitary, and secure environment.

The basic needs satisfied via mass care and human services vary little by disaster type, whether a chemical incident or a broader-based natural disaster, and whether accidental or intentional in nature. However, for a chemical incident, the level and extent of contamination may constrain the provision of mass care and emergency assistance needed by survivors. Hazardous materials expertise and sampling/monitoring data may be needed to identify areas where mass care services in the immediate incident area can be safely located; services to address many of the needs of survivors generally will only be available outside the contaminated area.[31] For example, if a chemical incident results in contamination of the local water supply, mass feeding sites should be located in areas where the water supply is not contaminated whenever practicable; otherwise, mass feeding sites must have procedures in place to obtain potable water, decontaminate tap water, or otherwise ensure that the water on-site is safe for its intended use (drinking, food preparation, cleaning, etc.). Chemical incidents also carry the potential need for mass human (and animal) decontamination.

Finally, delays in recovery activities or the need for extended timelines to achieve recovery outcomes due to contamination concerns may be experienced following chemical incidents.

Planners should be aware that some affected populations, such as individuals at lower socio-economic levels, non-documented residents, the homeless, and persons with disabilities or limited mobility, may experience disproportionate impacts from chemical incidents. These and other individuals may have limited financial reserves and their income may be disrupted in the aftermath of the incident and/or during response and recovery activities. In addition, responders themselves may be disproportionately harmed due to their close interaction with the event either medically, behaviorally, or socially, depending on the chemical released and the nature of the event.

1.1. Mass Care and Human Service Providers

Services and programs to assist impacted individuals are supported by a wide range of governmental, non-governmental (NGO), voluntary, and private organizations (discussed throughout this KPF). Collaboration and coordination strategies should be developed with all these entities before an incident happens to help ensure integrated operations in the aftermath of an incident and efficient and effective attainment of recovery outcomes. (Refer to KPF 3, Communicate with External Partners and the Public, for a discussion of communications for a coordinated response.) Voluntary organizations play especially important roles as they are among the first and last to provide survivor support services following any type of disaster, and their work often complements federal assistance programs. VOADs provide mass care services, conduct unmet needs assessments, manage donations and volunteers, conduct home repair, and provide other assistance. However, in a chemical incident, public fear may substantially diminish the number of volunteers available to provide survivor support services. Shelter-in-place orders and/or travel restrictions may further limit the number of volunteers able to serve. Moreover, the presence of contamination may limit the kinds of services volunteers are able to provide safely.

When the scope and scale of the incident necessitate federal assistance, FEMA coordinates and leads federal resources in support of SLTT and voluntary agencies, and itself provides mass care and transitional housing and other support. Federal sources of assistance are discussed further below.

Coordination Opportunity

Establish relationships with local and regional mass care and human services providers to build familiarity with available services and to help ensure integrated operations during a disaster. Discuss operational adjustments to the provision of basic needs in all-hazards disasters that may be necessary in a chemical incident. Establish mechanisms to ensure mass care and human services are efficiently and effectively supplied.

1.2. Evacuation and Sheltering

Depending on the nature of the chemical incident, people in the affected area may be told to shelter-in-place at a specific location or evacuate the area to prevent them from being exposed and/or contaminated. (Refer to KPF 4, Control the Spread of Contamination for additional information on these protective actions.) Communicating recommended protective actions (e.g., shelter-in- place, proceed with evacuation, etc.) with the public in an efficient and timely manner is essential to protecting life and health. (Refer to KPF 3, Communicate with External Partners and the Public for more information on public information and messaging.)

The requirements for facilities needed during and immediately after a chemical incident to support evacuation and sheltering/temporary housing needs will change depending on the type, scope and scale of the incident – including considerations such as:[63]

- How many people need to be moved?
- How far do they have to move?
- Are they and/or their service animals/pets contaminated?
- Do they require special medical treatment?
- Do they have a disability?
- How will families be reunified?

A jurisdiction's sheltering strategy should be layered: for example, if an incident impacts a single city block, the evacuees can be sheltered at congregate shelters or local hotels via existing American Red Cross (ARC) response protocols; for a larger incident, opening dedicated shelters would be required. As with all-hazards disaster events, officials planning for sheltering should prepare to set up shelters to serve disabled individuals and evacuees with animals, and anticipate the potential physical and mental health needs of these individuals. However, even with advance planning, shelter sites may not be fully equipped to address the short-term care needs and placement/disposition for the disabled, dependents (children, the elderly, etc.), and animals of those individuals who become incapacitated due to the chemical incident. In the wake of a chemical incident, equipping shelter facilities to detect, monitor, screen, and decontaminate humans and animals that were not decontaminated at the primary event location should be a serious consideration; this is discussed further below.

In the immediate aftermath of a chemical incident, transportation services may be needed to evacuate people and animals from the incident site and/or at-risk areas to mass care or health care facilities or areas of safety. Answers to the above questions will also dictate the types of transportation resources required to support evacuation, such as buses, paratransit, ambulances, etc.

Refer To

Mass Evacuation Incident Annex to the National Response Framework

1.2.1. TYPES OF EVACUATION FACILITIES

Different types of evacuation facilities may be needed during and after a chemical incident, depending on the scale of the incident.[63]

- **Evacuation Assembly Points** are temporary locations set up for evacuation embarkation and transportation coordination; other services are generally not available.
- **Emergency Respite Sites** are locations along an evacuation route that can support transportation- assisted evacuees and self-evacuees. Respite sites may include fuel stations, restroom facilities, and access to water.
- **Regional Hub Reception Centers (RHRCs)** are facilities where evacuees can receive assistance in identifying the most appropriate shelter location for their needs. RHRCs are typically state-run and employed during large-scale, multi- jurisdictional events.
- **Emergency shelters** assist in providing immediate lifesaving and sustaining care until conditions stabilize and full services can be established at shelter locations; they generally have limited supplies and services.
- **Shelters (mass care)** are facilities where evacuees receive disaster services from government agencies and/or pre-established volunteer organizations. Meals and water are available, as well as basic first aid, pet and service animal sheltering, sleeping quarters, and hygienic support, and basic disaster services (e.g., counseling, financial assistance, referrals) should be available. (Note, “shelter” refers to a fully functional evacuation shelter.)

Figure 60: Different services are provided at different types of evacuation facilities

1.3. Mass Care and Community Lifelines

Evacuations and shelter-in-place operations can serve as drivers and provide key data to inform FEMA’s Community Lifeline-related activities during the response to and recovery from a chemical incident.[63] The Community Lifelines construct allows emergency managers to distinguish the highest priorities and most complex issues from other incident information and maximize the effectiveness of federally- supported, state-managed, and locally-executed response and recovery activities. The Lifelines enable the continuous operation of government and business functions that are critical to human health, safety, and/or economic security, and provide a comprehensive aid for decision-makers when reviewing impacts and prioritizing resources and tasks to achieve incident stabilization.

Many mass care and human services fall under the Food, Water, Shelter lifeline. For chemical releases that pose a threat to human and/or environmental health, the Health and Medical and/or Hazardous Material lifelines apply. Evacuation and sheltering fall under the Safety and Security lifeline, although aspects of evacuation and shelter-in- place protective actions may influence key information points under additional lifelines. For example, shelter-in-place due to a hazardous material spill may contribute key information into the Transportation, Health and Medical, and Hazardous Materials lifelines. Stabilization and/or re-establishment of lifeline services are key to effective and efficient response and eventual attainment of recovery outcomes.

Figure 61: Relevant FEMA Community Lifelines

Refer To

FEMA's *Community Lifelines Implementation Toolkit* and the *Planning*, *Decision Support*, and *Modeling Resources for Chemical Incidents* section of this document for details on Community Lifelines

1.4. Information and Human Services Centers

In the minutes and hours immediately following a mass casualty chemical incident, individuals involved in the incident may seek recovery resources. Family members will gather where they believe they can locate or receive information about their loved ones (e.g., hospitals, designated reunification centers, incident site). Individuals involved in the incident may immediately seek assistance from all available sources: social and traditional media, emergency hotlines and call centers, hospitals, law enforcement, fire and emergency medical services, shelters, and the morgue/medical examiner/coroner. The needs of families and of survivors will vary and can best be met by establishing a call center and a reception center for collecting and providing information and services. These centers should be supported by subject matter experts in the particulars of chemical incident response to ensure provision of appropriate and correct information. Additional staff, possibly including HazMat and/or chemical SME, may be necessary to fulfill center needs for ready, reliable, and understandable information in a chemical incident.

Depending on the release scenario, information and human services centers of various types may be established in proximity to an area affected by a chemical incident. The locations of and the operational protocols used in these centers should reflect HazMat and chemical SME recommendations for protecting human and environmental health and avoiding the spread of contamination. As with shelters, centers also may not be equipped to serve humans and animals that were not decontaminated at the primary event location; this is discussed further below.

Different types of centers may be needed during and after a chemical incident to provide information (including chemical incident-specific information) and human services support to those affected by the incident:[48,67]

- *Hospital Family Information Centers/Family Support Centers (FICs/FSCs)* are healthcare facility- based locations that provide initial support to families arriving after the incident, assisting with reunification, notification, and providing information. (Some hospitals may use the terms Family Staging Area, Family Assistance Area, or Family Meeting Area.) These support functions move to a Family Reception Center (FRC) and/or Family Assistance Center (FAC) once opened.
- *Family Reception Centers (FRCs)* are centralized, temporary locations set up immediately post- incident for families and friends seeking trusted/official sources of information about loved ones. These centers are the responsibility of the affected jurisdiction; the lead agency will vary based on incident details and could be local police, fire, or emergency management, or a state or federal agency. The FRC may not have services available for families and should transition to FACs as soon as possible. (The term Family Reunification Center may be used.)
- *Family Assistance Centers (FACs)* are secure facilities, often established 24-48 hours after an incident, that provide information about missing or unaccounted persons and the deceased, and serve as a private “one-stop shop” of services for affected populations. FACs may offer assistance with mental health, spiritual care, and a variety of other short- and longer-term needs. Effective communication between agencies responsible for the provision of family assistance services is necessary to ensure efficient delivery of those services by identifying needs and coordinating/managing resource requests, especially when multiple FACs are opened; such coordination should be part of Incident Command activities. Depending on the incident, different agencies may be responsible for FAC activation; the American Red Cross (ARC) often supports the lead agency. Law enforcement investigations, including interviews and evidence investigations, may be ongoing at a FAC.
- *Hotlines/Call Centers* built upon existing capabilities like 311 may also be set up quickly, and are well-positioned to expand rapidly as needed. In the minutes and hours following a mass casualty incident, prior to the opening of FSCs/FRCs/FACs, the needs of family members seeking information on the status of their loved ones, or those reporting a missing loved one, can be met by a call center designed to collect and provide information.

Family reception centers (FRCs) operate for a few days while family assistance centers (FACs) may be in operation for 1-3 weeks. Center management should consider assisting with longer term plans to provide continued support and assistance to families once they depart the FAC.[67] Service provision hotlines may be established to provide mental health support, logistic support, emergency assistance services, legal services, and other information after the FAC is closed; they can also serve families that cannot (or choose not to) travel to the site. Voluntary organizations, including Voluntary Organizations Active in Disasters (VOADs), are often integral to the continued provision of human services throughout the recovery period and the efficient and effective attainment of recovery outcomes.

Refer To

- ASPR TRACIE *Tips for Healthcare Facilities: Assisting Families and Loved Ones after a Mass Casualty Incident* (2018)
- FBI-NTSB *Mass Fatality Incident Family Assistance Operations: Recommended Strategies for Local and State Agencies*

1.5. Decontamination Support

All persons, as well as any companion, service, and assistance animals, must be decontaminated prior to evacuating a contaminated area or entering any mass care facility to prevent the spread of contamination. Unfortunately, decontamination of all affected populations at the primary event location may not be possible. Decontamination facilities may not be readily available during the early stages of self- directed population evacuations, and it may not be possible to prevent unprotected people from leaving the contaminated zone. In fact, many individuals not debilitated by exposure likely will be gone before responders arrive. Moreover, depending on the size of the event, local decontamination resources may not be adequate to decontaminate all affected populations, their animals, and other belongings within the warm zone. See KPF 4, Control the Spread of Contamination for further discussion of decontamination.

Thus, unaware contaminated persons may seek entry to mass care facilities. Facilities may require additional detection, monitoring, screening, and decontamination capabilities to identify and accommodate those who were not decontaminated at the primary event location or another location prior to transport to the mass care site. Otherwise, facilities may become contaminated, adversely affecting resident health, long-term usability of the facility, and general public trust; adverse effects on public and/or environmental health and on timelines to achieving recovery outcomes also may ensue. Facility contamination can be mitigated by widespread awareness of the need for screening and decontamination among mass care response workers; such awareness can be facilitated by the inclusion of HazMat or chemical SME support in staffing plans. Depending on the nature of the event, this facility and survivor screening, monitoring, and decontamination may require specialized equipment and additional expertise, as well as PPE for shelter reception/registration officials. However, if these resources are not available, alternative methods such as questionnaires can identify the typical signs of possible contamination and recommend individuals and their belongings for decontamination.

A coordinated approach to “appropriate” decontamination procedures is essential. Conflicting approaches to decontamination at different locations must be addressed as they can result in increased anxiety in survivors and potentially additional people seeking medical care. Competing approaches may also strain available resources and complicate public messaging. A coordinated approach determined by incident command, poison centers, and medical toxicologists should be communicated to the public and to all mass care centers. In a chemical incident, the poison control center should play a key role in developing recommended actions for those leaving an incident site with potential exposure, those sheltering in place, and those displaced. Such recommendations can include procedures to self-decontaminate and contain potentially contaminated clothing or personal items for those at a facility that does not have decontamination capabilities. Further communications could identify symptoms that should prompt seeking medical care and other relevant risk information.

Action Item

Ensure adequate all-hazards sheltering and mass care plans are in place and coordinated, including consideration of contractual agreements and federal funds (if required) in accordance with federal procurement standards

- Identify alternate options for maintaining capabilities
- Ensure daycare centers, schools, businesses, etc., in your region have developed disaster family reunification plans

Pre-designate shelter and information and human services center location(s); if multiple, ensure all support locations are linked to facilitate communication, to share information - including tracking of patients and resources, and to maintain situational awareness

- It is a best practice to use well-known locations as shelter, mass feeding, or reception centers (e.g., schools, public recreation centers, convention centers)
- Establish agreements with such facilities
- Ensure sites are made known to local hospitals, emergency medical service providers, law enforcement, and emergency relief services/partners
- Coordinate with local hospitals to ensure their operational plans are interfaced with the community response plans
- Coordinate with HazMat and chemical SMEs to guide shelter and center operational protocols (including siting) to avoid the spread of contamination

Identify what type(s) of information may need to be provided to survivors, their loved ones, and community members in the context of a chemical incident that may differ from information needs for other types of incidents

- Identify additional staff/SMEs that may be needed in the various centers to provide such information

Establish mechanisms to ensure efficient and effective delivery of all needed services

- Determine the availability of voluntary and NGO partners to support human services needs
- Plan for appropriate scope and duration of sheltering resources based on anticipated needs
- Plan appropriate accessibility considerations for the disabled and other vulnerable populations, and ensure adequate availability of such resources
- Ensure mass care feeding plans consider dietary restrictions (i.e., low sodium); having appropriate emergency contracts for food provision in-place before an incident occurs will facilitate this

Establish goals and processes for the transition of FIC/FSC functions to FRCs and/or FACs

Check your jurisdiction for a registry and/or database maintained for evacuations (such as for hurricanes) which can help define transportation needs and locate transportation resources

What Will You Need to Know?

☐ How will you ensure mass care facilities are located in a safe, non- contaminated area?

- What hazardous materials expertise is needed?
- How will you obtain this expertise?
- How will sampling/monitoring data be provided to mass care decision makers?

☐ Are individuals evacuating or seeking mass care likely to be contaminated?

- How will contamination of evacuees, their animals and their property be assessed?
- What human and animal decontamination protocols are needed for evacuation facilities and mass care sites?

1.6. Considerations for Animals

Service animals and pets present complexities in managing a chemical incident as personnel supporting their care may be unavailable and owners' behaviors will reflect their concern for their animals, especially when evacuations are recommended. To promote human (owner) safety in disaster situations, FEMA took on the mission of ensuring animal safety and well-being during disasters, pursuant to the Pets Evacuation and Transportation Standards (PETS) Act of 2006. FEMA is supported in this role by other Emergency Support Function team members (for ESFs #6, #8, and #11, see Appendix F); foremost among these is the USDA Animal and Plant Health Inspection Service (APHIS) Animal Care program. USDA Animal Care assists states in preparing and implementing disaster animal care plans and supports networking and collaboration efforts. With USDA support, the National Alliance of State Animal and Agricultural Emergency Programs (NASAAEP) has developed disaster animal care planning guidance and veterinary "best practices" resources which cover issues such as animal decontamination, evacuation, transportation, sheltering, and disaster veterinary care.

Figure 62: Service animals and pets present complexities in managing a chemical incident

Refer To

The National Alliance of State Animal and Agricultural Emergency Programs (NASAAEP)'s resources, supported by USDA's Animal Care Program:

- *Disaster Veterinary Care: Best Practices* (June 2012)
- *Animal Evacuation and Transportation Best Practices* (June 2012)
- *Emergency Animal Sheltering Best Practices* (September 2014)

HHS Assistant Secretary for Preparedness and Response (ASPR)'s collection of information on Veterinary Issues that addresses disaster-related animal issues

2. Anticipate Public Fear and Mental Health Challenges

Following any disaster, behavioral and mental health effects should be anticipated within a substantial proportion of the affected population; effects may be significant, especially following large-scale or intentional incidents. These effects can include a negative perception of individuals, families, communities, ethnic/racial groups, or even certain professions that may become associated with the incident via media and other reports. In stressful situations, feelings of distress and anxiety about safety, health, and achieving recovery outcomes are also common. Survivors, responders, and community members can be expected to display a variety of symptoms and reactions, including:[68]

- Emotional symptoms such as irritability or excessive sadness

- Cognitive dysfunction such as difficulty making decisions or following directions
- Physical symptoms such as headache, stomach pain, or difficulty breathing
- Behavioral reactions such as increased dependency or abuse of drugs/alcohol or exacerbated interpersonal conflict
- Failure to adhere to needed physical or psychiatric medication needs

Chemical incidents can present special behavioral and mental health challenges in comparison with other types of disasters. On the one hand, exposures to many chemicals themselves may negatively impact an affected individual's mental status and mental health. Occupational exposures to a host of industrially-used chemicals, especially heavy metals and solvents, have long been known to be associated with the development of delirium, dementia, and delusional, mood, and anxiety disorders, and have been linked to disorders such as schizophrenia.[69] For agricultural workers, exposures to organophosphate pesticides (such as the event discussed in the Prologue) are linked to increased risk of depression and suicide. Memory impairment, anxiety, confusion, and irritability following exposure have been reported among these agricultural workers for over 50 years.[70]

From a community perspective, chemical incidents can leave a unique psychological footprint on affected populations because they often occur without warning, produce unfamiliar or unknown health effects, and can pose long-term threats to the community at large. Communities recovering from chemical disasters may experience higher levels of fear and uncertainty as well as increased feelings of blame and loss of control.[71] Questions about delayed health effects such as delayed onset of symptoms or long-term health effects such as cancer, effects on pregnant women, or children's developmental risks, will be on everyone's mind. In fact, for those released from care after exposure as well as those displaced (but not injured) by the incident, feelings of anxiety following a chemical exposure can be overwhelming. News stories and images of intensive decontamination procedures may instill the belief in survivors that everyone requires a high level of decontamination or other medical interventions. Addressing these fears should be a high priority action. Expert risk communication messages that coordinate information from Incident Command, poison control centers, public health experts, and state and local officials must be provided to the community and updated regularly. Rapid dissemination of risk information, frequently updated with new information, is one of the most effective ways of decreasing public fear and avoiding/defusing the potential for widespread civil/social unrest. Decreased anxiety will additionally benefit already strained healthcare resources, as fewer minimally exposed individuals will feel compelled to seek medical evaluation.

> *Chemical incidents can have unique psychological impacts because they often occur without warning, produce unfamiliar or unknown health effects, and can pose long-term threats.*

Affected communities may also face a decreased willingness from outsiders to provide assistance after a chemical incident, whether intentional or not, out of fear of contamination hazards. This increases the survivors' risk of experiencing mental health effects over that seen for other types of disasters. In addition to addressing community concerns, expert risk communication messages can also serve to decrease outsider anxiety. On the other hand, the health impacts of psychological exposure to chemicals can extend far beyond the geographical area in which the actual physical exposure occurs. In a study comparing oil-exposed and non-exposed communities, perceived exposure to spilled oil (perceived risk) was associated with greater levels of anxiety and depression than was actual physical exposure to oil. In fact, many studies report that populations affected by oil spills have elevated anxiety, depression, and post-traumatic stress disorder (PTSD).[72,73]

At the individual level, survivors of chemical disasters are at heightened risk for chronic stress due to a fear of uncontrollable and invisible physical deterioration.[74] For example, suffering the effects of a chemical incident, such as a chlorine gas exposure resulting from a train derailment, has been associated with long-term increased post-traumatic stress (PTS) symptoms.[75]

Individuals exposed to chemical substances in the context of war have been known to experience anxiety, depression, and symptoms of PTSD (decades later) at rates far higher than individuals within the same conflict, but not exposed to chemical weapons.[76] Over the long term, individuals exposed to the chemical warfare agent sulfur mustard in Iraqi Kurdistan described feeling that the agent had become permanently integrated into their bodies and was continuing to damage their organs years later, with profound long-term negative effects on their quality of life.[77] Even three decades later, survivors reported experiencing difficulty sleeping, depression, irritability, anxiety, suicidal ideation, and symptoms of PTSD.

In large-scale or intentional chemical incidents, many individuals may suffer behavioral and mental health effects and may seek medical assistance. If not mitigated by behavioral and medical triage, the ability of medical facilities and workers to assist those with physical injuries can be quickly overwhelmed. The provision medical care for physical injuries is discussed in KPF 6, Augment Provision of Health and Medical Services to Affected Population.

Behavioral health issues may be significant and could overwhelm existing counseling professionals and facilities, especially since these issues will call for less traditional methods of delivering psychological support.

2.1. Populations at High Risk

Particular circumstances may add to a person’s risk for developing serious behavioral and mental health problems following a chemical incident, such as: surviving/witnessing mass destruction or death, unresolved bereavement, loss of home or community, displacement and separation from trusted support systems (for example, due to sheltering or evacuation), history of prior trauma, and experiencing major life stressors (e.g., divorce, job loss, financial losses). Some population segments, such as children, the elderly, and those with existing mental health or substance use problems, are at higher risk of experiencing severe adverse stress reactions and suffering serious mental or emotional distress.[68,74]

Leveraging the community’s resources and services for these high-risk groups is essential in both the short and long term. Health professionals should routinely screen individuals who are at greater risk for short- and long-term adverse stress reactions, and behavioral and mental health interventions should be offered by specialists or by trained and supervised community workers in the health and social sector.[68] The Health & Social Services Recovery Support Function (RSF) of the National Disaster Recovery Framework (NDRF) may need to convene specific groups of relevant personnel to help communities address the health, behavioral health, and social services needs of those in high-risk groups, and those who support and care for them.

Response and cleanup workers exposed during their jobs are also at risk for developing mental health effects. For example, following the Deepwater Horizon oil spill, workers exposed to oil, dispersants, or other cleaning chemicals (e.g., benzene, toluene, ethylbenzene, xylene, 2-butoxyethanol, and propylene glycol) were at increased risk for depression and post-traumatic stress, as well as deficits in attention, memory, and executive function.[78] Similar results were seen for workers at the Exxon Valdez and other oil spills.[73,79] A specific and coordinated risk communication effort targeting responders/workers and their families to address their fears regarding chemical exposure is critical. Responders should be provided clear guidance about potential harmful effects of exposure to themselves, their children, and to other family members, and when to report symptoms or seek medical care. Responders are also susceptible to stress resulting from their incident response roles. They demonstrate mental and emotional resilience during an operation but have intense emotional reactions afterwards. Care provision plans should include mental health assistance programs for responders during and after their deployment.

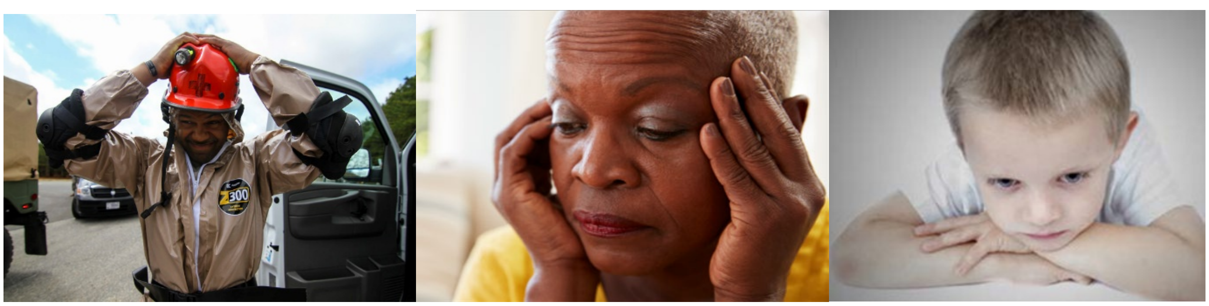


Figure 63: Many members of the population will be at risk for developing mental and behavioral health problems following a chemical incident

2.2. Long-Term Considerations

Mental health care needs may change over the course of incident response and recovery as survivors, and the impacted community writ large move from initial stress/shock reactions to more long-term effects that can include depression, substance abuse, and PTSD and other anxiety disorders. Early post-incident behavioral and mental health interventions are designed to mitigate the increased prevalence of long-term psychiatric disorder in the affected population. Such interventions include assistance provided by behavioral health professionals, trained in disaster response, who work in shelters and medical and psychiatric facilities or perform other community outreach and educational activities to facilitate individual and community resiliency and achieve recovery outcomes. (See also KPF 7, Augment Essential Services to Achieve Recovery Outcomes.)

Refer To

Communicate with External Partners and the *Public Key Planning Factor* section of this document for more information on public information and messaging to minimize and/or negate fear and stigmas

- *Disaster Mental Health Services: A Guidebook for Clinicians and Administrators*
- *Health & Social Services Recovery Support Function* (RSF)

Coordination Opportunity

Build relationships with mental health partners, public health officials, private and public medical providers, community stakeholders, academic institutions, and school officials. Together, establish the role of partners in mental health services during an emergency and develop agreements for the provision of mental health staff, including medical and psychology students, following an incident.

Action Item

Establish a disaster mental health preparedness working group to develop community objectives for disaster mental health services and procedures for emergency response. Ensure these are incorporated into the community's overall disaster plans and incorporate the needs of survivors, responders, and the community. Efforts should include:

- Finding behavioral health treatment facilities in your state
- Identifying and training mental health professionals and response staff to provide counseling, triage, outreach, and education during a crisis or emergency
- Training social and community leaders on how to help their groups cope, including public health nurses, school health professionals, and community support workers
- Developing a triage system to connect survivors with emergency mental health services when needed
- Working with Regional FEMA counterparts to learn how to take advantage of the Crisis Counseling Assistance and Training Program (CCP)
- Developing and exercising de-escalation training and techniques, including the use of harm-reduction approaches

3. Federal Assistance for Mass Care and Human Services

Mass care and human services requirements may rapidly exceed the capabilities of SLTT departments, agencies, and NGOs in affected and nearby jurisdictions. During a multi-state or catastrophic incident, there may be shortages of critical resources including food, potable water, trained personnel, warehouses, transportation, and housing. These shortages will likely be exacerbated due to the unique impacts of chemical incidents as discussed above. Each SLTT and/or federal stakeholder may seek to independently acquire needed resources; however, varying SLTT and federal authorities and regulations may inhibit the acquisition of resources necessary to support response operations directly associated with the procurement of supplies and/or delivery of mass care services. Therefore, ensuring that life-sustaining services are provided to disaster survivors and impacted, nearby jurisdictions requires coordination across government, NGOs, VOADs, faith-based organizations, and private sector entities.

FEMA plays the key coordination role for federal assistance including for resource acquisition and deployment, and implementation of financial, and/or direct assistance programs. As a component of the overall response, FEMA Mass Care administers programs that include feeding support, crisis counseling, disaster unemployment assistance, legal services, case management, temporary housing, and loans (see box). FEMA hosts Disaster Recovery Centers (DRCs), which are fixed or mobile facilities that provide a central location where FSLTT and non-governmental organizations can provide recovery information, assistance, and services to disaster survivors.[80]

For chemical incidents specifically, FEMA can provide referrals to local COSS and chemical release modeling capabilities, among others. As chemical safety professionals, COSS can provide expert chemical information to responders and emergency managers, are familiar with what federal resources can be brought in to assist response and recovery activities, and can assist communications staff in simplifying and clarifying information. FEMA's IMAAC provides access to modeling resources that can help determine appropriate courses of action, including what areas to evacuate and what areas can safely support shelters and information and human services centers. (A host of such resources are described in the Planning, Decision Support, and Modeling Resources for Chemical Incidents section of this document; chemical incident response teams that may be able to assist in response and recovery activities are listed in Appendix G. For more information on the application of modeling information for the protection of area populations, see KPF 4, Control the Spread of Contamination.)

When federal support is requested, ESF #6 – Mass Care, Emergency Assistance, Housing, and Human Services is the overarching interagency collaboration and coordination group activated to assist individuals impacted by potential or actual disasters. ESF #6 support comes from over a dozen federal agencies as well as volunteer and non-governmental support organizations. FEMA serves to coordinate and lead federal resources to support SLTT and voluntary agencies in performance of activities under ESF #6 and the Mass Evacuation Incident Annex to the National

Response Framework. Services and programs implemented under ESF #6 include those supported by FEMA's Mass Care component and many others, and are organized into four primary functions:

- **Mass Care**: Includes sheltering, feeding operations, emergency first aid, and bulk distribution of emergency items.
- **Emergency Assistance**: Assistance required by individuals, families, and their communities to ensure that immediate needs beyond the scope of the traditional "mass care" services provided at the local level are addressed. These services include: support to evacuations (including registration and tracking of evacuees); reunification of families; provision of aid and services to special needs populations; evacuation, sheltering, and other emergency services for household pets, service, and assistance animals; support to specialized shelters; support to medical shelters; non-conventional shelter support; coordination of donated goods and services; and coordination of voluntary agency assistance.
- **Housing**: Includes housing options such as rental assistance, repair, loan assistance, replacement, factory-built housing, semi-permanent and permanent construction, referrals, identification and provision of accessible housing, and access to other sources of housing assistance.
- **Human Services**: Includes the implementation of disaster assistance programs to help disaster survivors recover their non-housing losses, including programs to replace destroyed personal property, and help to obtain disaster loans, food stamps, crisis counseling, disaster unemployment, disaster legal services, support and services for special needs populations, and other federal and state benefits.

FEMA Voluntary Agency Liaisons (VALs) or ESF #6 coordinators work with VOADs to facilitate additional mass care support activities. The American Red Cross works with FEMA to provide services under the NRF and ESF #6; this role is separate and distinct from ARC's role as the nation's largest local-level mass care service provider to survivors of every disaster.

FEMA programs designed to support disaster survivors include:[80]

- *Disaster Unemployment Assistance (DUA)* provides unemployment benefits and re-employment assistance services to survivors affected by a disaster who are not eligible for regular state unemployment insurance.
- *Disaster Case Management (DCM)* employs partnerships between case managers and disaster survivors to assess and address unmet needs and develop disaster recovery plans that include guidance on decision-making.
- *Disaster Legal Services (DLS)* provides legal aid to survivors affected by a presidentially declared major disaster who qualify as low-income and are limited to cases that would not normally incur legal fees. This aid typically includes help with insurance claims (e.g., health, property, or life), recovery or reproduction of lost legal documents, help with home repairs and disputes with contractors and/or landlords, the preparation of powers of attorney and guardianship materials, and FEMA appeals.

- The *Crisis Counseling Assistance and Training Program (CCP)* provides funding to assist disaster- impacted individuals and communities in recovering from adverse reactions to disasters and rebuilding their lives through community-based outreach and psycho-educational services.
- *Mass care and emergency assistance* staff and resources can be deployed to local response centers in affected areas and offer services including: sheltering; feeding; distribution of emergency supplies; support for individuals with disabilities and limited mobility; reunification services; support for pets, service, and assistance animals; and mass evacuee support.
- *Voluntary Agency Liaisons (VALs)* support and collaborate with voluntary organizations to provide technical guidance and program information, and assist in the development of long-term recovery groups. Voluntary organizations provide mass care services, conduct unmet needs assessments, manage donations and volunteers, conduct home repair, and other assistance. These groups are among the first and last to provide survivor support services post-disaster, and their work often complements federal assistance programs.

Additional mass care and human services support activities are directed by the following ESFs:

- ESF #8 – Public Health and Medical Services, led by HHS
  - Supports behavioral needs consisting of both mental health and substance abuse considerations for survivors and response workers, individuals in need of additional medical response assistance, and veterinary and/or animal health issues.
- ESF #10 – Oil and Hazardous Materials Response, led by EPA and/or USCG
  - Supports decontamination actions for hazardous substances, pollutants, and contaminants.
- ESF #11 – Agriculture and Natural Resources, led by USDA
  - The Food and Nutrition Service (FNS) identifies, secures, and arranges for the transportation of food and/or the provision of food stamp benefits to affected areas and supports FEMA Mass Care in providing food for shelters and other mass feeding sites.
  - USDA's Food Safety and Inspection Service (FSIS) ensures the safety and security of the nation's commercial food supply (e.g., meat, poultry, and egg products), and mitigates the effect of the incident on the U.S. population and environment.
  - USDA APHIS supports FEMA to ensure an integrated response that provides for the safety and well-being of household pets during emergency events that result in the mass displacement of civilian populations.
  - Department of the Interior (DOI), as the primary agency for natural and cultural resources and historic properties (NCH), organizes and coordinates the capabilities and resources of the Federal Government to facilitate the delivery of services, technical assistance, expertise, etc. for the protection, preservation, conservation, rehabilitation, recovery, and restoration of NCH resources.

Refer To

National Response Framework (NRF), including:

- *ESF #6* – Mass Care, Emergency Assistance, Housing, and Human Services
- *Mass Evacuation Incident Annex*

Planning Considerations: Evacuation and Shelter-in-Place (July 2019)

Post-Disaster Reunification of Children: A Nationwide Approach (November 2013)

Individual Assistance Program and Policy Guide (IAPPG) (March 2019)

National Food and Agriculture Incident Annex *to the Response &* Recovery *Federal Interagency Operational Plan (FIOP), August 2019*

Federal Preparedness, Response, and Recovery section of this document for more information on available federal support mechanisms for response activities

Appendix F of this document for more information on Emergency Support Functions.

3.1. Animal Care Resources

In its mission of ensuring animal safety and well-being during disasters, FEMA is supported team members from the NRF's Emergency Support Functions #6, #8, and #11 and the Mass Evacuation Incident Annex. Overall support comes from the USDA APHIS Animal Care program, while the National Veterinary Response Teams (NVRT) of the National Disaster Medical System (NDMS) (described further in KPF 6, Augment Provision of Health and Medical Services to Affected Population) and the Veterinary Medical Assistance Teams (VMAT) of the American Veterinary Medical Association (AVMA) can deploy to sites to provide emergency veterinary expertise and care.

4. Special Mass Care and Emergency Assistance Considerations

The context in which a chemical incident occurs will determine which response and recovery plans are appropriate and define the activities that follow. The need for mass care in response to a chemical incident occurs against a backdrop of operational constraints governed by other public health considerations. While public health emergencies are rare, the fact that a chemical incident can be triggered by another disaster (for example, an earthquake or a hurricane, as described in the Prologue) implies that mass care needs arising from a chemical incident may often occur in the context of a larger ongoing event that has its own mass care needs. In 2020, for example, response and recovery to natural disasters incidents in the United States required adaptations to mass care and emergency assistance service plans – particularly mass sheltering assistance – due to the Coronavirus Disease 2019 (COVID-19) pandemic.[81] If there are stresses on PPE supplies due to other ongoing events, both responders to the chemical incident and mass care service providers may face shortages in PPE that hamper their ability to do their jobs safely.

Coordination Opportunity

SLTT leadership should establish coordination and management mechanisms that can be used across multiple all-hazards incidents and that focus support on SLTT-prioritized outcomes. A State Disaster Recovery Coordinator (SDRC) or Tribal Disaster Recovery Coordinator (TDRC) could lead recovery organization and priority setting and serve as the jurisdiction's primary point of contact with state and federal agencies to resolve unmet recovery outcomes.

Action Item

Establish plans to augment mass care and human services by:

- Becoming familiar with state, regional, and local plans for mass care and human services, including services for animals, and including any plans specific to chemical incidents
- Determining requirements for, and sources of, the resources for mass care and human services after a chemical incident needed for event response and recovery, including emergency assistance and temporary housing programs as well as supplies of decontamination equipment and PPE
- Planning for the varying requirements and special physical and mental health needs of individuals affected by a chemical incident, including those who require and utilize the assistance of family members, personal assistants, and/or service animals
- Establishing links and referral mechanisms between mental health specialists, general health- care providers, community-based support groups, and other services (e.g., schools, human services and emergency relief services such as those providing food, water and housing/shelter)

What Will You Need to Know?

☐ What are the sizes and locations of populations in your region?

- Rural? Suburban? Urban?

☐ Where will the community reception centers and/or shelters be?

- What are their capacities?

☐ What all-hazards mass care plans are in place in your region?

☐ What will be needed in different chemical events?

- For example, what will be the contamination spread considerations?
- How will community reception centers and/or shelters identify potential sources of contamination and limit contamination spread?
- How will shelter/reception center staff be protected against potential contamination?
- What if staff resources for community reception centers and/or shelters are injured or do not want to come in during a chemical incident?

☐ How will you conduct health screenings of evacuees that may enter sheltering locations?

- How will you know if there are any workforce or resource constraints?

☐ What purposes will the centers and/or shelters fill in various chemical incidents?

- Personal protection?
- Contamination screening?
- Decontamination?
- Limited medical evaluation and care?
- Emergency first aid?
- Temporary housing?
- Disaster welfare information?
- Food service?
- Health and mental health services?
- Ongoing health surveillance?

☐ How will assistance from voluntary organizations be coordinated?

- Do the agencies/organizations have specific policies regarding assistance during a chemical incident?

☐ What additional human services and SLTT public health resources, including counseling and mental health resources, are available in your region?

- What are their capabilities and capacities?
- How do you contact them?

☐ What is the plan for handling anticipated behavior impacts?

- How will they be managed and resourced?

☐ How will you gather and synthesize information in order to continue evaluating and providing medical and behavioral health services to affected populations?

☐ What are the reunification plans of daycare centers, schools, businesses, etc, in your region?

☐ What are the pertinent memos of understanding (MOUs)/memos of agreement (MOAs) required to facilitate for medical care, services, etc., in the aftermath of a chemical incident?

☐ Do you have reopening and reconstitution criteria that support the recovery of businesses impacted by a chemical incident in an environment characterized by additional, longer-term public health restrictions?

What Would You Do?

...if the occupants of a city block need to be decontaminated and evacuated?

...if a family and their dog arrive at a shelter but have not been decontaminated yet?

What are the most vulnerable populations?

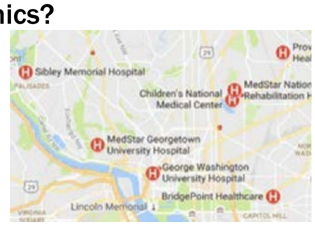
Daycare centers and pre-schools

Senior citizen centers, nursing homes, assisted living facilities

Where are emergency services, hospitals, and clinics?

Base helipads

Fire stations



Hospitals

Emergency Medical Services

KPF 6 Augment Provision of Health and Medical Services to Affected Population

The size, scope, and/or complexity of a chemical incident may overwhelm existing regional, state, and local capabilities and resources, causing significant strain on the whole community. Shortfalls in the availability of personnel, materiel, facility space, and systems during response and recovery are likely and should be anticipated during a chemical incident, particularly one with significant potential for the spread of contamination or human and/ or environmental health consequences. In such cases, the federal government will support affected areas with available federal resources and assist in their prioritization and coordination throughout the incident.

1. Provision of Medical Care

Survivors of a chemical incident often need immediate treatment to save lives and address injuries. However, by their nature, chemical incidents, even non-"catastrophic" incidents, make timely provision of treatment difficult. The provision of health and medical services to the affected population following a chemical incident faces several hurdles, including, but not limited to:

- The speed with which most chemical exposures produce illness and injury. To save lives, first responders and healthcare personnel may be forced to work with limited knowledge and provide medical care without knowing the identity of the released chemical.
- The lack of a specific antidote or treatment for most chemical exposures. Although appropriate non-specific care can effectively support the recovery of patients suffering an injury due to chemical exposure or contamination in many cases, the absence of a specific antidote or treatment for a chemical's effects can limit the lifesaving capabilities of healthcare providers.
- A medical infrastructure that is ill-equipped to handle mass casualty events. Local medical infrastructure can be overwhelmed by the sheer number of individuals seeking care in a short period of time; a large proportion of these may be minimally exposed.
- A medical infrastructure that is ill-equipped to handle contaminated patients who pose hazards to pre-hospital emergency medical services personnel, healthcare providers, and other patients in a hospital emergency department setting.

Survivors may require treatment rapidly, but chemical incidents make timely provision of care difficult.

1.1. Provision of Timely Care

During a chemical incident, the specific chemical hazard and exposure route may not be known for some time, complicating and potentially delaying the provision of effective medical treatment to affected individuals. Decontamination of survivors, essential equipment, and urgent care facilities prior to reuse (for example, ambulances) may also be necessary and may further delay other lifesaving treatments. First responders and medical personnel must understand that because many chemical exposures produce illness and injury quickly, they may need to provide medical treatment with limited information. Patient signs, symptoms, and accounts may in fact be the most useful and timely information available to inform incident management. Determining proper decontamination procedures with limited information can also be difficult and may again rely on patient condition.

For these reasons, first responders and healthcare personnel should be familiar with the toxidromes described in KPF 2, Recognize and Characterize the Incident, and with chemical casualty treatment and basic decontamination principles. Fortunately, many of the chemicals that produce a similar toxidrome are treated by addressing that symptom suite. For example, a survivor presenting with SLUDGEM signs and symptoms (see Appendix B) can be treated with atropine whether they were exposed in an accident at a pesticide facility or during an attack with a nerve agent. Moreover, basic decontamination procedures are the same for many chemicals, and can be applied based on the symptom suite as well (see discussion in KPF 4, Control the Spread of Contamination). Prior instruction in chemical casualty care and readily available information regarding treatment protocols, such as those obtainable from the local poison control center, will ensure that staff are not caught off-guard and unprepared for a situation where lifesaving interventions must occur within moments of exposure.

Chemicals for which there is a delay in the onset of signs and symptoms after exposure pose daunting challenges for treatment. Many of those who received a harmful dose will likely have left the incident area prior to symptom onset. The development of widespread but potentially sporadic adverse health effects may delay event recognition, accurate diagnosis, and the delivery of appropriate treatment. Decontamination efforts will also be hampered and/or be made more complex in these circumstances

Coordination Opportunity

A collaborative effort amongst EMS and emergency department (ED) physicians, emergency management personnel, poison control centers, and medical toxicologists should be pursued to develop protocols for the treatment of specific chemical exposures (tailored to local chemical risks, as defined in KPF 1, “Prime the Pump” Pre-Event Planning), a strategy to coordinate treatment recommendations and protocol adaptation during a chemical incident, and training and exercises for these protocols/strategies. Efforts should also include developing a strategy for determining where MCMs (including therapeutics, diagnostics, PPE, and medical devices) are most likely to be effective in the local area (e.g., at the incident scene and/or EDs), as well as methods to coordinate MCM availability at those sites.

Action Item

Ensure first-responder and medical staff are prepared to care for chemical casualties with limited information. Personnel should be familiar with:

- Chemical toxidromes
- The quick-response support available from the Poison Control Center
- Training and response support tools, such as the prototype Chemical Hazards Emergency Medical Management Intelligent Syndromes Tool (CHEMM-IST), which uses patient signs and symptoms to predict the exposure chemical type and identify appropriate medical care for inhalational exposures

1.2. Medical Treatment for Chemical Casualties

Rapid decision-making by first responders and receivers will be needed to ensure survivors of a chemical incident are provided available treatments that will best alleviate and reduce adverse health outcomes. These decisions will be based on information regarding the chemical released, medical condition of survivors, and locally available medical treatments and countermeasures. The following framework should guide the provision of medical treatment to chemical casualties, based on the information available. An operational mapping of this framework is provided in Appendix I.

1. Symptomatic and supportive care to treat the patient's condition based solely on evident signs and symptoms, and not based on specific knowledge of the offending chemical. Attention should be paid to basic life support measures (Airway, Breathing, Circulation, ABCs) and to treating specific manifestations such as seizures.
2. In addition to (1), add treatments that are specific for treating poisoning from a specific group of chemicals, based on toxidrome.
3. Refine treatment based on additional, reliable information regarding the causative agent. Therapeutics specific for the agent may be utilized.

Several factors can substantially influence the efficiency and efficacy of these treatment steps; the importance of these factors to saving lives and alleviating or preventing further injury cannot be over-emphasized. Firstly, the speedy provision of basic supportive care for chemical incident survivors is paramount. For chemical injuries, supportive care is often the best medical choice; basic life support alone can treat many poisonings, including those for which specific countermeasures exist. For example, administering oxygen to a survivor of exposure to a lung irritant is often what is needed to restore/maintain respiratory function as the body self- clears the lungs. The Poison Control Center is an invaluable resource for guiding treatment management, providing specific recommendations for MCM administration, and identifying alternatives and adapting protocols in a scarce resource environment.

Secondly, reliable information must be used to refine medical treatment. The reported output of chemical detection technology at the scene or suspected source of exposure based on placards or other scene evidence must be consistent with the observed clinical manifestations (toxidromes, see Appendix B). These are very important “detectors” for determining appropriate treatment. When the expected clinical effects based on initial reports do not align with the observed clinical findings, additional investigation should be initiated at the scene to determine the specific cause of the observed signs and symptoms to facilitate appropriate treatment.

The goal is to administer the right drug by the right route in the right dose to the right patient at the right time to save lives and alleviate injuries.

Finally, the challenge of providing a smooth transition of care from on-scene providers to receiving hospital staff must be addressed. Critical communication steps include notifying hospitals in advance of the arrival of patients needing additional countermeasures or critical care, and clearly documenting any on-scene treatments (often not done in mass casualty incidents).

In some cases, the recovery process for injured patients will include the long-term use of specialized drugs and/or medical equipment; planners should consider the overall cost and supply chain considerations concerning this long-term care.

1.3. Availability of Medical Countermeasures

MCMs and other effective treatments can significantly reduce the harm caused by many chemical incidents, mitigating resulting injuries and saving lives. In many instances, chemical exposures can be treated using locally-held MCMs, although challenges to administering those treatments remain. In particular, some countermeasures must be applied very soon – within an hour – after exposure to save lives, meaning that earlier intervention can improve clinical outcomes. Therefore, first responders should be equipped to administer such countermeasures whenever possible. Further, large quantities of appropriate antidotes may not be at the ready. Many hospitals stock only enough of these types of drugs to treat a few patients, and are not adequately supplied and equipped to treat mass chemical casualties. Unfortunately, for some chemical exposures, no immediate, specific medical treatment or therapeutic will be available locally.

Thus, even smaller-scale chemical incidents may result in the need for more chemical- specific MCMs or other resources than are present in a single community. This further challenges a jurisdiction’s ability to provide lifesaving treatments quickly. For particular chemicals, the CHEMPACK component of the Strategic National Stockpile (SNS) program represents an efficient mode for the nearly immediate provision of extra MCMs to affected areas.

CHEMPACKs are containers of nerve agent antidotes placed in secure locations in local jurisdictions around the country to allow rapid response in the event of an attack on civilians with nerve agents. Most are located in hospitals or fire stations selected by local authorities to support a rapid HazMat response and can be accessed quickly when needed. Even so, CHEMPACKs face challenges to their effective use. Firstly, their usefulness is more or less restricted to response to nerve agent attacks, including poisoning with organophosphate or carbamate pesticides. Further, CHEMPACKs do not include supplies for responder workforce protection; therefore, implementing specific plans for the co-deployment of a cache of PPE and other supplies would augment the ability of responders to quickly and safely leverage CHEMPACKs in a mass casualty treatment scenario. Moreover, while more than 90 percent of the U.S. population is within 1 hour of a CHEMPACK location,[82] the lack of effective logistics plans in most jurisdictions may hinder their timely deployment. Given the rapid onset of most nerve agent (and similar) exposures, any delays in treatment can present a challenge to lifesaving capabilities.

Figure 64: First responders prepare for CHEMPACK training

Depending on the size, scope, and type of chemical involved in an incident, additional MCMs and other supplies may be available for delivery from the SNS (non- CHEMPACK) to the affected area. The SNS, which is managed by the HHS Office of the Assistant Secretary for Preparedness and Response (ASPR), holds stocks of pharmaceuticals (medications, antibiotics, IVs) and medical supplies (e.g., equipment, surgical items, PPE, etc.) that may be required to control and/or respond to a public health emergency. However, activation of the SNS is generally too slow a process to effectively aid in the initial treatment of chemical casualties, as the governor of the affected state must request SNS resources, and delivery times (not including distribution to area hospitals for support of patient care) are 12 hours in the best case. When the MCM has no treatment benefit after the day of exposure, planners should assume that the main use of the SNS is to replenish local stocks.

The non-pharmaceutical interventions discussed in KPF 4, Control the Spread of Contamination (evacuation or sheltering-in-place, facility closure, food recall, and isolation of goods and materials), may be used as a stopgap measure to bridge the time not only between recognition of the incident and containment of the released substance, but also between event recognition and the arrival of additional therapeutics, or as the predominant intervention when therapeutics to treat the exposure do not exist.

1.4. Veterinary Care

In the aftermath of a chemical incident, household pets, service, and assistance animals as well as livestock may require veterinary care to alleviate and reduce adverse health outcomes. The USDA's Animal and Plant Health Inspection Service (APHIS) maintains a National Veterinary Stockpile (NVS) that includes pharmaceuticals as well as equipment for use in veterinary emergencies, including PPE and decontamination supplies. The APHIS Animal Care program can also provide technical assistance and expertise, including veterinary support.

What Will You Need to Know?

- ☐ How will you know if there are the appropriate MCMs and enough doses of MCMs in your region?
- What will you do if there is a shortage?
- What will you do if the appropriate MCMs are not available?
- Where are the materials stored and how can they get to where they are needed?
- ☐ Where and how many CHEMPACKS are in your local jurisdiction and surrounding areas?
- ☐ What are the plans for SNS distribution in your state? In your region?
- ☐ What are the plans for NVS distribution in your state? In your region?

Coordination Opportunity

Engage a whole-of-community effort in developing, testing, and exercising MCM distribution and dispensing plans. Ensure all stakeholders understand the importance of providing consistent, coordinated, accurate, accessible, timely, and understandable information to the public.

Refer To

CDC/Agency for Toxic Substances and Disease Registry (ASTDR)'s *Managing Hazardous Materials Incidents (MHMI)* series:

- Volume I – Emergency Medical Services: A Planning Guide for the Management of Contaminated Patients
- Volume II – Hospital Emergency Departments: A Planning Guide for the Management of Contaminated Patients
- Volume III – Medical Management Guidelines for Acute Chemical Exposures

Strategic National Stockpile for information regarding the contents of and access to the SNS, including CHEMPACKs

The National Alliance of State Animal and Agricultural Emergency Programs (NASAAEP)'s *Disaster Veterinary Care: Best Practices* (June 2012)

ASPR's collection of information on disaster-related veterinary issues

Action Item

- Establish protocols and procedures for the prioritization of medical resources among population segments
- Ensure local public health authorities are familiar with SNS activation procedures. Checkout the ASPR's comprehensive SNS planning as well as your local public health department's plans for MCM distribution
- Ensure local public health authorities are familiar with the NVS request process

What Would You Do?

...if there is a large-scale chemical spill for which there are no existing pharmaceutical interventions or countermeasures?

1.5. Resilience of Medical Infrastructure

Depending upon the size and severity of the incident and the robustness of local medical and veterinary infrastructure, the local or state capacity to provide appropriate care and services in the response to a chemical incident can be quickly overwhelmed. On a smaller scale, a local hospital may be overwhelmed with injured patients following a transportation HazMat accident; for example, a train derailment that released chlorine severely taxed the nearby hospital as only one physician was on duty in the emergency department.[21] On a larger scale, a mass influx of patients in a short period of time, including those potentially contaminated by the chemical substance, could cripple the medical infrastructure of any large city. This happened in Tokyo following the 1995 subway sarin attack, with over 600 patients reporting to a single nearby hospital within a matter of hours, and more than 5,500 total patients reporting to hospitals city-wide over the course of the response.[22]

In general, first responders will treat exposed individuals for three purposes: to improve health outcomes, minimize contamination spread, and address public concerns. Due to the potential for overwhelming nearby medical facilities, responders should triage injuries and implement controls for patient flow. Initial treatment should focus on preventing further exposure, and may include decontamination steps that eliminate further exposure (such as transdermal exposure), especially when secondary exposure may be a concern (such as secondary vapor exposure), as discussed in KPF 4, Control the Spread of Contamination.

The use of staged triage, on-scene, at designated offset locations, and at nearby medical facilities, is an important strategy for maximizing the reach of limited medical resources, as well as for controlling the spread of contamination. However, in a mass casualty event, local hospitals must be prepared for patients to arrive who are not contaminated but believe they may be, particularly those who choose to "self-report" rather than being transported to a hospital in an EMS vehicle or ambulance. For example, ambulances are reported to have transported only 688 of the more than 5,500 patients seen in hospitals after the Tokyo subway attack, meaning that well over four thousand people reached hospitals by alternate means – on foot, via taxi, and private vehicles – and can be assumed to have bypassed on-scene triage stations.[21,22] As discussed in KPF 4, Control the Spread of Contamination, hospitals should develop procedures for patient triage and decontamination following a chemical release.

Given the potential for a large proportion of patients to present independently to a medical facility, timely and detailed official messaging is critical for directing public movement such that any particular medical facility is not overwhelmed. To support the sustainable distribution of patients across available medical facilities, authorities need to develop clear, easy-to-understand messaging that can effectively direct patient movement and jurisdiction-wide healthcare provision strategies that can accommodate large numbers of patients.

Public concern for exposure, similarity of initial signs and symptoms to those common to stress and anxiety (racing heartbeat, dizziness, nausea), and the lack of definitive knowledge about the extent of the affected area may amplify the demand for medical and health resources. In Tokyo, doctors and nurses faced the daunting challenge of distinguishing the 1,000 truly injured from the asymptomatic, possibly exposed or minimally exposed individuals, while simultaneously trying to diagnose the cause of the mass illness and determine an appropriate treatment.[22] This situation underscored the criticality of pre-planning and swift implementation of key communications strategies for a successful response (as described in KPF 3, Communicate with External Partners and the Public). Only by providing clear and concise information in the most timely manner possible to the public can the anxiety that causes otherwise healthy people to go to hospitals be allayed.

Large numbers of concerned citizens may seek medical assistance, which, if not mitigated by behavioral and medical triage, can quickly overwhelm the ability of medical facilities to assist the injured.

The activation of pre-existing mutual-aid agreements can relieve the pressure on local medical facilities by coordinating the transfer of staff, medication, and equipment from unaffected jurisdictions. Having these plans in place beforehand is critical, as again illustrated by the 1995 sarin release in Tokyo. While other nearby hospitals offered to take some of the patients from the single hospital that received 640 patients, there was no disaster plan or means for interhospital transport of patients, and first responder ambulances were unavailable. The overwhelmed hospital was forced to handle the influx of patients on its own. As a result, patients were treated in virtually every space in the hospital – in the chapel, the outpatient department, the halls, and wards – and by any available staff, no matter their medical specialty. Staff were too overwhelmed to complete even standard medical charts.[22]

Figure 65: Practicing triage and the provision of medical services during a National Disaster Medical Services exercise

Coordination Opportunity

Hospitals should build mutual-aid agreements that can be called upon to help coordinate acquisition of additional staff, medication, and equipment. Such agreements are often supported by health care coalitions (HCC) funded via HHS/ ASPR Hospital Preparedness Program (HPP) grants

Action Item

Planners should develop strategies for guiding the movement of resources and the public following a chemical release to ensure medical needs are safely met. Efforts should include:

- Determining requirements for, and sources of, the health and medical services resources needed during the response to a chemical incident

- Developing protocols and procedures for timely communication with supporting (i.e., poison control) and receiving agencies (i.e., hospitals) to maintain situational awareness of health/medical infrastructure and service status
- Developing messaging strategies that can effectively direct patient movement and reduce the numbers of minimally exposed individuals seeking care
- Developing jurisdiction-wide healthcare provision strategies that can accommodate large numbers of patients while implementing decontamination procedures

What Will You Need to Know?

- ☐ Who will you contact to find out the type of chemical that was released?
- ☐ Who will you contact to find out if there are treatments available?
- ☐ What are the vulnerable populations and where are they concentrated?
- ☐ General population or selected segments (e.g., children, the elderly)?
- ☐ Animal or human?
- ☐ Where are the hospitals and clinics in your region?
- ☐ What are their specialties/capabilities?
- ☐ Number of beds?
- ☐ ICU capacity?
- ☐ Number of ventilators? Respirators?
- ☐ Where are additional medical services in your region (e.g., public health resources)?
- ☐ What are their capabilities and capacities?
- ☐ What are the locations of SLTT public health resources?
- ☐ What are their capabilities and capacities?
- ☐ How will surge be addressed at hospitals and healthcare facilities?
- ☐ How will you manage the asymptomatic, possibly exposed and minimally exposed populations?
- ☐ What are the pertinent memos of understanding (MOUs)/memos of agreement (MOAs) (for medical care, lab services, etc.)?
- ☐ Does your area have a relationship with 3-1-1 for a chemical incident?
- ☐ How will you know if PPE is necessary?
- ☐ If PPE is necessary, how will you know what is needed and what the existing inventory is?
- ☐ Who will you contact for PPE in your region?
- ☐ If there is a shortage of PPE, what will you do?

☐ Are any additional protocols needed for public safety and security?

1.6. Additional Public Health Considerations for Provision of Care in Disasters

The day-to-day medical needs of individuals remain integral to their health and well- being during disasters. Patients will need reliable access to medications and care for conditions and injuries that are not related to the chemical incident. Planners should consider ways to ensure priority care needs are met and access to pharmaceuticals continues. For example, planning should consider the needs of diabetic patients, patients on dialysis, patients receiving antiretroviral therapy, and individuals receiving addiction treatments, as well as other elements of populations that have historically faced disruptions in care during all types of disasters.

The wider public health context in which a chemical incident occurs will also influence the ability of local health and medical personnel to provide timely and appropriate care to survivors. For much of 2020, for example, normal day-to-day medical care was constrained as facility space, staff, and equipment/supply stocks (including PPE) were stretched thin due to the COVID-19 pandemic. In an area where demands for medical care are already high and healthcare system resilience low, response to a mass casualty chemical incident is likely to face significant challenges.

Calling upon mutual-aid agreements with other jurisdictions may not be possible if nearby medical systems are facing similar situations. Although difficult, planning for such extremes should be considered, and should include procedures for enacting necessary extra protective measures (PPE, distancing, and health screening), and filling extra supply needs (cleaning and disinfectant products). Federal resources that may be tapped for assistance in these types of situations are discussed below.

1.7. Agricultural Incidents

USDA is responsible for coordinating veterinary or agriculture support to affected states and premises during incidents harming either plant or animal agriculture. Emergency response operations during an agricultural incident that involves livestock or other large animal populations will need a sufficient number of veterinarians and animal health technicians to manage a variety of critical actions: 1) ongoing animal health and animal care issues, 2) access to additional veterinary testing and diagnostics that support the identification of contaminated premises and animals/plants and of the contaminant itself, and 3) preventing contaminated materials from reaching the food supply. Where contamination is found, movement will be halted in and out of the premises, animals will be depopulated (plants will be removed by “roguing”) and safely disposed of, and the area will be decontaminated. The NVS includes equipment for use in veterinary emergencies, including PPE and decontamination supplies, depopulation equipment, and large animal handling equipment. In addition to providing resources to be used on animals, NVS resources (PPE, etc.) may be provided to agricultural responders.

Coordination Opportunity

Work with partners, public health officials, and updated guidance to generate flexible plans that ensure continuity of care. Further, work to ensure all aspects of plans can be effectively executed in a pandemic or other high medical need environment.

Refer To

- *Federal Preparedness, Response, and Recovery* section of this document for additional information on inter-agency coordination in response to agricultural incidents
- National Food and Agriculture Incident Annex *to the Response & Recovery Federal Interagency Operational Plan (FIOP), August 2019*

Action Item

Determine requirements for, and sources of, resources for veterinary treatment for response to and recovery from a chemical incident

What Will You Need to Know?

- ☐ What veterinary services will be required and where?
- ☐ How will you find out about workforce or resource limitations for veterinary services?
- ☐ If there are resource issues, what will be the recommended alternatives?

1.8. Fatality Management

Two of the biggest challenges with fatality management during a chemical incident are that (1) the human and animal remains may be contaminated, and (2) in some cases, fatalities represent critical pieces of evidence in a law enforcement or and/or safety investigation, depending on the cause of the incident. Fatality management protocols also can vary based on the chemical type. The federal government will provide evidence collection guidance during an intentional chemical incident. Through Disaster Mortuary Operational Response Teams (DMORTs, discussed further below), the federal government also will provide technical assistance and consultation on fatality management and mortuary affairs.

What Would You Do?

...with remains that are possibly hazardous and/or are possibly evidence?

Coordination Opportunity

Coroners, medical examiners, federal support teams (DMORTS), etc. should develop mutual aid agreements across jurisdictional boundaries that can be called upon the help coordinate fatality management needs.

Action Item

Determine requirements for, and sources of, resources for Fatality Management Services

What Will You Need to Know?

- ☐ Who has the authority at the local and state level over fatality management - medical examiner, justice of the peace, other?
- ☐ What are their chemical response plans?
- ☐ Based on the chemical agent, what will be the fatality management protocol?
- ☐ For hazardous human remains?
- ☐ For hazardous animal remains?
- ☐ For evidence?
- ☐ For cultural or religious considerations?
- ☐ How will you know if there are any workforce or resource limitations for fatality management?
- ☐ If limitations arise, what will be the recommended alternatives?

2. Federal Assistance for Health and Medical Services

2.1. Personnel and Material Assistance

As the sections above detail, SLTT entities may lack the capability to immediately provide sufficient care, MCMs, and/or PPE in the aftermath of a chemical incident. Availability, overwhelming public demand, and requests beyond impacted areas may make MCM and/or PPE distribution challenging; available MCMs and/or PPE may fall short of demand due to factors such as the geographical extent of contamination, logistical issues, or disruptions to production. In such cases, the federal government will assist SLTT entities with MCM/PPE distribution. HHS coordinates the federal emergency public health and medical response via ESF #8 – Public Health and Medical Services, which supports medical response assistance, including behavioral needs consisting of both mental health and substance abuse considerations for survivors and response workers, and veterinary and/or animal health issues.

Support from federal, state, NGO, and volunteer labor forces may be required to assist overwhelmed healthcare staff.

If staffing needs surpass those addressable by surge support from nearby jurisdictions (discussed above), federal assistance for overwhelmed healthcare staff may be requested, although federal team deployment can take 12-48 hours. The National Disaster Medical System (NDMS) is a federally coordinated health care system and partnership of the Departments of Health and Human Services, Homeland Security, Defense, and Veterans Affairs that is designed to support SLTT authorities following disasters and emergencies by supplementing health and medical systems and response capabilities. Specifically, the NDMS provides patient care and movement, veterinary services, and fatality management support to requesting SLTT authorities or other federal departments via specialized teams (see below):[83,84]

- Disaster Medical Assistance Teams (DMATs)
- Trauma and Critical Care Teams (TCCTs)
- Disaster Mortuary Operational Response Teams (DMORTs)
- Victim Information Center Teams (VICs)
- National Veterinary Response Teams (NVRTs)
- National Medical Response Teams (NMRTs)

Additional health and medical assistance may come from within and from outside the federal government. Both skilled and non-skilled labor forces may be called upon to provide service in accordance with their capabilities. Assistance may come from agencies supporting ESF #6 (Mass Care, Emergency Assistance, Housing, and Human Services), ESF #8 (Public Health and Medical Services), and others, such as:

- HHS Commissioned Corps of the U.S. Public Health Service (USPHS) Readiness and Deployment Operations Group (RedDOG) available within 36 hours[84]
    - Rapid Deployment Force – for mass care at shelters (including FMSs, see below) and staffing at MCM/PPE distribution and casualty collection points (available within 12 hours)
    - Applied Public Health Team – for assistance in public health assessments, environmental health, infrastructure integrity, food safety, vector control, epidemiology, and surveillance
    - Mental Health Team – for assessing stress within the affected population and responders, and providing therapy and counseling
- CDC Epi-Aid teams, which provide epidemiologic assistance to SLTT public health investigations, including those of illnesses and injuries resulting from natural or manmade disasters such as

chemical spills or pipeline explosions, and abnormal signs and symptoms following food ingestion or pharmaceutical use

- Medical Reserve Corps (MRC), a national network of medical and public health professionals who are coordinated at the local level to serve as volunteers in natural disasters and emergencies
- Non-governmental organizations (NGOs)/Volunteer Organizations Active in Disasters (VOADs) and nonclinical volunteers
- Emergency Management Assistance Compact (EMAC), a compact for state-to-state personnel, equipment, supply, and other assistance

Figure 66: Available NDMS teams include DMORT and NVRT support staff

National Disaster Medical System (NDMS) Teams[83,84]

Disaster Medical Assistance Teams

Disaster Medical Assistance Teams (DMATs) provide medical care during public health emergencies or National Security Special Events (NSSEs), such as:

- Triage, primary, acute, and stabilizing emergency care
- Emergency department decompression
- Inpatient care augmentation
- Supporting patient movement/transfer, including ill/injured and nursing home patients
- Staffing casualty/patient collection points
- Mass prophylaxis
- Medical site/shelter operations

DMAT teams include advanced clinicians (nurse practitioners/physician assistants), medical officers, registered nurses, respiratory therapists, paramedics, pharmacists, safety specialists, logistical specialists, information technologists, and communication and administrative specialists. DMATs of 35 personnel deploy to disaster sites within 48 hours with supplies and equipment for a period of 72 hours; the personnel are typically activated for a period of two weeks.

Trauma and Critical Care Teams

Trauma and Critical Care Teams (TCCT) provide trauma and critical care support during public health emergencies and special events including NSSEs. TCCTs can provide a deployable advance unit, augment existing medical facilities, or establish a stand-alone field hospital. The capabilities of the TCCT include:

- Critical care and advanced trauma life support
- Emergency care
- Operative care

TCCT personnel are deployed for fourteen days or until local medical resources are sufficiently recovered or have been supplemented by other organizations.

Disaster Mortuary Operational Response Teams

Disaster Mortuary Operational Response Teams (DMORTs) provide victim identification, mortuary services, and technical assistance and consultation on fatality management and mortuary affairs, including:

- Tracking and documenting human remains and personal effects
- Documenting field retrieval and morgue operations
- Establishing temporary morgue facilities
- Assisting in the determination of cause and manner of death
- Collecting ante-mortem and post-mortem data
- Collecting medical/dental records or DNA of victims from next of kin to assist in the forensic identification of the victims
- Performing forensic dental pathology and forensic anthropology methods
- Processing and re-interment of disinterred remains preparation

Teams are composed of funeral directors, medical examiners, pathologists, forensic anthropologists, fingerprint specialists, forensic odonatologists, dental assistants, and administrative and security specialists. DMORTs may deploy with a Disaster Portable Morgue Unit (DPMU), which contains a complete morgue and prepackaged equipment and supplies.

Victim Information Center Teams

A Victim Information Center (VIC) Team provides support to local authorities after a mass fatality or mass casualty incident by collecting ante- mortem data and serving as liaison to the victims' families or other responsible parties in support of another NDMS team. The VIC Team provides support by:

- Providing subject matter expertise in mass fatality management and victim information procurement

- Training partners to appropriately gather the information required for victim identification from the family interview process
- Collecting dental records, medical records, DNA, and other ante-mortem data
- Explaining the HIPAA Privacy Rule Exemption for Medical Examiners and Coroners at 45 CFR 164.512(g)(1) to medical and dental providers to facilitate obtaining records
- Coordinating and sharing data with morgue and forensic staff for potential identification
- Coordinating with FSLTT law enforcement to facilitate victim identification and manage the missing persons list
- Maintaining the Victim Identification Program (VIP) database
- Coordinating the release of remains

National Veterinary Response Teams

A National Veterinary Response Team (NVRT) is the primary federal resource for the treatment of injured or ill animals affected by disasters. The NVRT is composed of veterinarians, animal health technicians, epidemiologists, safety specialists, logisticians, communications specialists, and other support personnel. A NVRT is supported by a cache of equipment, supplies, and pharmaceuticals, and provides assessments, technical assistance, and public health and veterinary services, such as:

- Assessments of the veterinary medical needs of animals and communities
- Veterinary medical support to working animals which might include search and rescue dogs, horses, and animals used for law enforcement
- Veterinary public health support including environmental and zoonotic disease assessment

National Medical Response Teams

National Medical Response Teams (NMRTs) provide medical care following a nuclear, biological, and/or chemical incident. Each team of 50 personnel is capable of providing mass casualty decontamination, medical triage, and primary and secondary medical care to stabilize victims for transportation to tertiary care facilities in a hazardous environment.

2.2. Space and Systems Assistance

Federal medical stations (FMS) are also available upon request from the SNS.[84] These rapidly deployable caches contain beds, supplies, and medicines which can quickly transform any building into a temporary medical shelter during an emergency. Each FMS comes with a three-day supply of medical and pharmaceutical resources to sustain from 50 to 250 stable primary or chronic care patients who require medical and nursing services. FMS facilities generally are staffed by local or regional personnel or from the USPHS. Potential roles for an FMS include the following:

- Provide temporary holding and care for patients to decompress a local hospital (increase beds available for patients with disaster-related trauma or illness)

- Receive patients from nursing homes and skilled nursing facilities forced to evacuate due to the disaster
- Provide low acuity care for patients with chronic illnesses whose access to care is impeded due to the disaster

Significant preparation is needed to employ FMSs in support of SLTT emergency plans, as a FMS must be established in a structurally intact, accessible building with adequate hygiene facilities and functioning utilities (hot and cold potable water, electricity, heating, ventilation, and air conditioning, and internet accessibility or capability). A 250-bed FMS requires roughly 40,000 ft2 of open space, while a 50-bed FMS requires about 15,000 ft2. Logistical services must be in place before an FMS can be operational, such as a 10-12 person set up team, contracted support for patient feeding, laundry, ice, medical oxygen, and biomedical waste disposal. Once a request for an FMS has been approved, the cache of equipment and supplies will be delivered in 24-48 hours.

The federal government also will assist with integrating health services with other non-medical disciplines such as emergency management and law enforcement.

Coordination Opportunity

Coordinate with local NGOs, including schools of medicine and other health care-related academic and training centers, and Volunteer Organizations Active in Disasters (VOADs), to determine their resources and capabilities and develop a volunteer management plan for chemical incident response.

Refer To

- *ESF #8 — Public Health and Medical Services* including resources available through the National Disaster Medical System for patient care, patient movement, and definitive care, as well as veterinary services and fatality management support.
- *CDC's Public Health Preparedness Capabilities* for additional information on public health preparedness
- Federal Interagency Concept of Operations- Rapid Medical Countermeasures Dispensing (September, 2011)
- *Defense Support of Civil Authorities (DSCA)* for information on military support

What Will You Need to Know?

- ☐ How will you know the impact (and projected impact) on the workforce – first responders, emergency management, hospitals, clinics, laboratories, other medical and public health professionals?

- ☐ What workforce and logistical considerations will be necessary to work around the workforce impacts?
- ☐ What resource limitations could impact incident response and recovery outcomes?
  - Medical equipment?
  - Pharmaceuticals?
  - Personal protective equipment?
  - Others?
  - What will you do to work around various resource limitations?
- ☐ What federal and SLTT governmental organizations will be part of the public health and medical response?
  - What and how will they contribute to the incident response?
- ☐ What non-governmental medical and/or healthcare coalitions and organizations will be part of the public health and medical response?
  - What and how will they contribute to the incident response?
  - Check out Whole Community and consider how individuals, NGOs, VOADs, and the private sector may be able to provide capabilities.
- ☐ How will you manage volunteers?
  - Who are the key contacts?
  - What assets are available?

Figure 67: Federal Medical Station set up at a municipal sports complex in Manatí, Puerto Rico

KPF 7 Augment Essential Services to Achieve Recovery Outcomes

A community's ability to achieve recovery outcomes in the aftermath of a chemical incident rests on several important considerations. People, businesses, property, and the environment may all have been harmed by the incident. The operation of critical infrastructure may be disrupted or otherwise limited due to the injury of personnel, lack of resources, physical damage, and/or contamination of impacted facilities. Medical care for the injured, health surveillance for those exposed, and housing options for those displaced by the incident may be needed for the long term. The whole community, including local businesses, may be suffering economically. Cleanup activities (site remediation) may generate large quantities of contaminated waste that require long-term disposal. Costs to achieve recovery outcomes may be substantial. Plans made and actions taken early during the response can help mitigate these and other long-term consequences, including potentially reducing the time to and cost of achieving recovery outcomes following a chemical incident.

1. Recovery Begins During Planning and Response

Decisions made during pre-incident planning and actions taken during the response have the potential to significantly reduce the time and cost spent recovering from a chemical incident as well as the human and environmental health consequences incurred. For example, actions taken to minimize contamination spread save resources and benefit public health and safety by reducing the area and population requiring remediation, decontamination, or treatment. Early efforts to identify exposed individuals can facilitate their treatment and the provision of any needed long-term medical care and monitoring. Timely and informative communications with partners and the public will build trust and buy-in for integrated operations decisions. In fact, many initial recovery activities take place in parallel with similar response activities. Therefore, planning for recovery is as critical as planning for response, and essential recovery activities should be implemented as early as possible after an incident to ensure effective and efficient attainment of recovery outcomes.

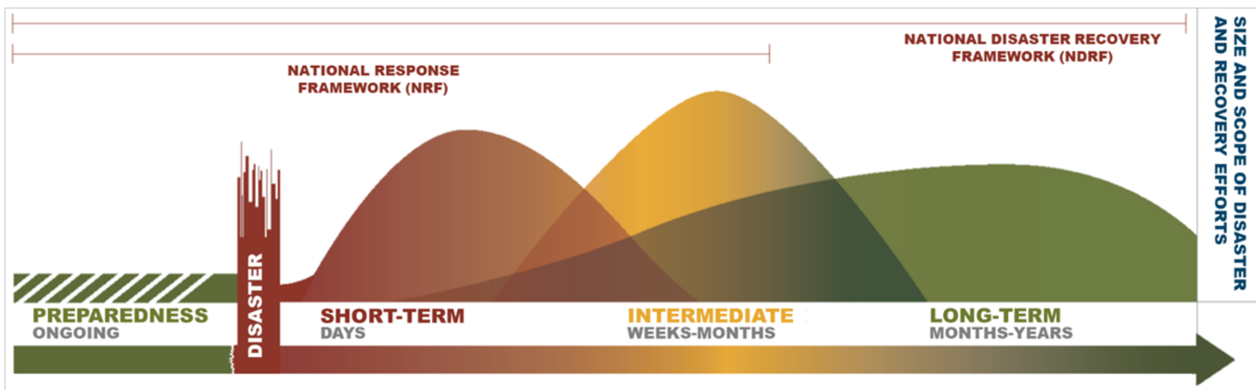
Planning for recovery is as critical as planning for response.

Refer To

- *National Disaster Recovery Framework* (NDRF) (June 2016), which comprises six Recovery Support Functions (RSFs) that coordinate key areas of assistance.
- Response & Recovery Federal Interagency Operational Plan (FIOP) (December 2021)

- FEMA Recovery Operations Support Manual, Draft (November 2020)
- DHS-EPA *Draft Planning Guidance for Recovery Following Biological Incidents* (May 2009) (this guidance has also been applied to chemical incidents)
- *Pre-Disaster Recovery Planning Guide for Local Governments* (2017)
- *Pre-Disaster Recovery Planning Guide for State Governments* (2016)
- *Pre-Disaster Recovery Planning Guide for Tribal Governments* (2019)
- Planning for Post-Disaster Recovery: Next Generation

As described in the NDRF and shown below, the Recovery Continuum can be divided into three time-based phases (short-, intermediate-, and long-term).



SHORT-TERM

- Health and safety needs beyond rescue
- Assessment of damages
- Restoration of basic infrastructure
- Mobilization of recovery organizations and resources
- Restarting and restoring essential services for recovery decision-making

INTERMEDIATE

- Return of individuals, families, critical infrastructure, and essential government or commercial services to a functional temporary or pre-disaster state
- Regional priorities, strategies, goals, and decision-making
- Risk assessment for remediation decision-making, including considerations for long-term human and environmental health monitoring
- Regional prioritization of area and facility recovery
- Characterization of extent of contamination
- Decontamination of contaminated items, areas, and facilities
- Site-specific remediation and restoration (characterization, decontamination, clearance), and reoccupation
- Waste management

LONG-TERM

- Continue remediation and restoration to meet clearance, restoration, and reoccupancy goals
- Complete redevelopment and revitalization of the impacted area
- Rebuild or relocate damaged or destroyed social, economic, natural, and built environments
- Move to self-sufficiency, sustainability, and resilience
- Continue waste management

1.1. Set and Review Priorities for Recovery

Activities and resources needed to attain recovery outcomes will vary depending on the scenario, context, and location of the chemical incident as well as the incident's impacts on the local infrastructure, economy, and workforce. Many response activities described earlier in this document will continue into and throughout the recovery phase, although they may change in focus and intensity. For example, with the immediate hazard addressed during response, the overall objectives of recovery plans and prioritizations are to restore critical services as quickly as possible to limit cascading effects, and to return the affected community to a sense of normalcy. Meeting these objectives should be based on community, regional, and national needs, including:

- Protecting human and animal health and safety
- Minimizing disruption to the economy
- Ensuring continuity of government and business operations
- Minimizing environmental impacts
- Maintaining national security

At recovery outset, infrastructure recovery objectives should be clearly identified and prioritized. Highest priority should be given to restoration of:

- Infrastructure assets that produce significant capacity, or provide multiple high-priority services
- Dependencies that enable the highest priority government and commercial services and assets to function
- "Cornerstone" industries central to the region's economy[85]

Lower priority can be given to services and assets that are redundant, easily replaced, or not necessary for the functioning of other services and assets. Resources may need to be reprioritized if any of these qualities cease to be true during the response. Reprioritization may also be needed if restoration timelines for high priority infrastructure and services are not being met. In fact, for all recovery activities, decisions made during pre-event planning should be continually re-assessed as the situation changes and new information emerges.

The operation of critical infrastructure may be limited due to personnel injuries, lack of resources, and/or contamination.

Hazard impacts may affect national and global markets. The resulting commercial implications (e.g., supply chain) will challenge response and recovery actions.

1.2. Potential Recovery Limitations

The presence of widespread contamination following a large-scale incident is likely to substantially influence recovery priorities and timelines and could restrict the affected community's ability to effectively and efficiently achieve recovery outcomes. Widespread contamination could limit the usability of infrastructure (including housing) in the area. Property values will be drastically reduced, and property owners, who are not likely to be insured against chemical contamination (especially from a terrorist attack), will incur major financial losses from the incident and may be displaced for an extended period of time. In fact, in the incident's aftermath, many commercial buildings and private residences may be abandoned. The community's population may face relocation in the long-term as individuals act on fears over short- and long-term health risks.

In severe circumstances, businesses in the area may close in response to public health fears, creating both immediate and downstream economic effects. The demand for goods and services produced in the region is likely to drop dramatically, and large employers may be forced to move or close due to labor shortages, nonfunctional critical infrastructure, supply disruptions or lack of a customer base. In the long-term, state and local governments could face significantly reduced revenues due to a restricted tax base; meanwhile, they will likely struggle to find immediate financing for recovery expenditures that may be reimbursed at a later time.[85] Planners and decision-makers should bear these possibilities in mind when considering recovery strategies following an incident with significant contamination issues.

Coordination Opportunity

Bring together emergency planners, infrastructure owners, and other private and public stakeholders in neighboring jurisdictions to consider and negotiate restoration objectives and priorities. Planners should work closely with the private sector to coordinate resources and recovery efforts, and provide information to instill confidence in the long-term viability of the regional economy.

Action Item

Establish plans for guiding long-term activities and resource allocations that:

- Consider the potential impacts of a wide-area chemical scenario on regional critical infrastructure and service delivery
- Assess critical infrastructure and services status, post-incident
- Prioritize recovery objectives
- Prioritize critical infrastructure and services restoration based on factors such as: infrastructure or service asset status, interdependencies, and relationships to recovery objectives; contributions to services; workaround availability; and recovery milestone requirements
- Prioritize the restoration of services required for the provision of medical and mental health care
- Continually re-assess priorities to account for situational changes as recovery proceeds
- Compare the restoration timeline with milestone requirements and assess whether all requirements are being met (and if not, consider re-prioritization or development of alternative workarounds)
- Account for other federal, regional, and SLTT plans for response to and recovery from a chemical incident and continuity plans in your region that may impact your planning

2. Support the Affected Population and Community in Achieving Recovery Outcomes

Many of the economic, housing, physical and behavioral health, and social services provided to affected populations during response and early recovery following a chemical incident (discussed in KPF 5, Augment Provision of Mass Care and Human Services to Affected Population) may need to be continued for the long term. The provision of survivor services after assistance centers have closed will involve agencies and organizations that did not play a major role in the initial response, such as state and local mental health agencies and long-term housing authorities, as well as the continued support of voluntary and private organizations. Planning will be needed to ensure all needed services transition from the reception/assistance center hubs to providers of long-term survivor/family services.

Mechanisms for continuing emotional and social support at the community level should also be considered, as everyone who participated in the response will be affected by the incident – survivors, their loved ones, law enforcement, EMS, other responders, hospital staff, and the staff of assistance and sheltering centers. For example, London established a “Family Resiliency Center” after their 2005 mass transit bombings, acknowledging that many might need emotional support over a longer period of time. Similar centers were established in Las Vegas, Orlando, and Boston after they suffered mass casualty events. Multiple, coordinated pathways to healing for all involved can help ensure community resilience.

For large-scale or highly toxic chemical releases especially, the affected population may need access to event-related health services for an extended period of time. Recall that survivors of chemical incidents can face special physical, behavioral, and mental health challenges in comparison with other types of disasters. Long-term medical monitoring of exposed and potentially exposed populations and the provision of monitoring and long-term care for those with medical complications and/or chronic effects caused by the chemical may be needed. For example, long-term surveillance for cancer and birth defects among the exposed population may be recommended, depending on the substance released; injured patients may require long treatment regimens with specialized drugs. In addition, strategies, systems, and facilities for the provision of ongoing medical care for the potentially large population of displaced persons, such as those normally residing in long-term care facilities, those undergoing dialysis, and those receiving antiretroviral therapy, among others, must also be arranged. For all types of health challenges, assistance in accessing essential medications – including those for addiction treatment – may be needed when infrastructure systems are impaired.

For efficient and effective attainment of recovery outcomes, the community’s health care system must also address the full range of psychological, emotional, and behavioral health needs associated with the disaster’s impact and resulting recovery challenges. Behavioral health assistance provided in recovery may include provision of information and educational resources, basic psychological support and crisis counseling, assessment, and referral to treatment when needed for more serious mental health or addiction issues.[86] Again, ensuring affected populations have reliable access to needed medications throughout recovery is essential. In some chemical release scenarios, especially those resulting in persistent contamination, reoccupation of affected areas may be delayed or prohibited, and populations may need housing assistance for an extended time. As part of their sheltering plans, SLTT authorities should outline a transition from mass sheltering to alternate options, including Transitional Sheltering Assistance (TSA) for eligible applicants if a major disaster declaration is approved, or for a timely termination when sheltering is no longer needed. When housing assistance is still needed as recovery progresses beyond sheltering activities, the provision of such housing assistance is guided by the Housing RSF under the NDRF. Options for rental assistance, repair, loan assistance, replacement, factory-built housing, semi-permanent and permanent construction, referrals, and for the identification and provision of accessible housing should be considered. For incidents in which homes or neighborhoods were contaminated or destroyed, permanent housing solutions may include rapid remediation of homes, construction of new homes, and/or development of communities adjacent to the contaminated area (that can support businesses within the region). The availability of housing solutions has the potential to significantly impact the community's ability to achieve economic recovery outcomes, as without adequate housing availability, people may not be able to remain in the area, depriving the community of its workforce and local business market.[85]

Finally, the community's economy plays a key role in its overall health and resilience. Community-wide attainment of economic recovery outcomes may require long-term efforts to restore and/or maintain an environment in which local businesses can return to operation or continue to operate. Restarting and recruiting businesses back into the impacted region so that life can transition to a "new normal" following a large-scale chemical incident may also require levels of trust, transparency, and stakeholder involvement well beyond those needed following traditional natural disasters. The situation may also be leveraged to create new employment opportunities in the region, as residents could be trained to conduct remediation operations. The pre-incident development of plans enabling state and local governments and business leaders to take prompt, coordinated steps shortly after an incident will reduce the incident's economic impacts and support the return of business activities and a sustainable and economically viable community.[85]

Figure 68: Achieving recovery outcomes will require meeting the multifaceted needs of the community, including housing, healthcare, and economic needs

Refer To

National Disaster Recovery Framework (NDRF)'s six [Recovery Support Functions (RSFs)]

Coordination Opportunity

Community engagement is essential for planning to support the attainment of economic recovery outcomes. Build relationships with housing, health, and social services providers and business leaders in your region and together develop agreements for provision of services and economy-building activities while working toward recovery outcomes.

Action Item

Develop a set of coordinated actions and measures to support the region's people, businesses, government, infrastructure, and environment

- Become familiar with transitional, short-term, and permanent housing options in your area
- Become familiar with behavioral and mental health and social services providers in your area
- Maintain confidence in the government response and the region's recovery by developing plans to provide unemployment insurance, housing assistance, and health and medical support
- Develop plans that enable SLTT governments and business leaders to take economic recovery actions shortly after an incident
- Explore incentives to help businesses overcome challenges and identify and eliminate disincentives when and where possible

2.1. Maintain Communications with Partners and the Public

Public anxiety may be heightened following a large-scale chemical incident as compared with natural disasters. Therefore, maintaining the confidence in governmental decisions and direction that was carefully built via public communication strategies during early response activities (see KPF 3, Communicate with External Partners and the Public) is a major goal. A long-term public affairs campaign that provides consistent, valuable information to both partners and the public throughout recovery regarding the areas of contamination, health risks, and timelines for remediation and reoccupation will help to reduce public anxiety and achieve this goal.

Over the long-term, successful attainment of community recovery outcomes will require community-wide understanding and "buy-in" on recovery decisions, activities, and costs. Maintenance of strong lines of communication between local officials and the public that includes robust and transparent avenues for the two-way transfer of ideas and information will be needed to reach community recovery goals. Since the health and economic welfare of affected populations are likely to be closely linked to recovery activities, these populations and the community at large must feel some "ownership" in ongoing recovery activities. For this to occur, representatives from all population segments, including local officials, business owners, response workers, healthcare workers, service providers, school officials, environmental and natural resource advocates, members of low-income communities, members of communities of color, persons with disabilities, persons with access and functional needs, older adults, and persons with limited English proficiency, must be engaged in recovery planning and decision-making.

Coordination Opportunity

Engage local leaders in efforts to achieve recovery outcomes, including representatives of low-income communities, communities of color, homeless communities, persons with disabilities, older adults, persons with limited English proficiency, etc. Having trusted local communicators amplify your message will help to ensure recovery efforts are delivered in an equitable and impartial manner and that recovery decisions have community-wide "buy-in."

2.2. Ensure Continuity of Operations (COOP) and Continuity of Government (COG)

Ensuring continuity of operations (COOP) and government (COG) is crucial for the success of all recovery programs. Both small- and large-scale chemical incidents have the potential to challenge continuity of operations, as chemical incidents may impede the timely movement of personnel, patients, MCM, PPE, and remediation/ decontamination and other supplies and equipment into and out of affected areas. Waste management can also be a challenge, as discussed further below. Coordinated efforts are essential for efficient restoration of transportation pathways and critical infrastructure, and to support supply chains.

Plans and activities that support Continuity of Operations (COOP) and Continuity of Government (COG) should be implemented throughout all phases of recovery. Such implementation will rest heavily on the plans and prioritizations made during pre-event planning as well as decisions made throughout response and recovery.

The federal interagency can contribute personnel, resources, and other support to supplement state and local resources, as well as coordinate a larger-scale (multi-state, national, or international) response and recovery. The federal government can provide guidance and recommendations for interstate and/or international travel and mass transit, and personnel to assist in the transport of critical supplies. In addition to supporting COOP, these federal assistance efforts can support a positive business environment for achieving economic recovery outcomes. Federal support for recovery activities is described further in the Federal Preparedness, Response, and Recovery section of this document.

2.3. Recovery from Food or Agriculture Incidents[87]

Response to and recovery from a food incident includes both short- and long-term actions to protect the public from the food incident, restore public confidence in the safety of the food supply, and ensure the future safety and availability of food products. Eliminating any ongoing threat is critical for recovery. Therefore, recovery activities for food incidents include:

- Inspecting/investigating regulated facilities to collect and analyze samples from implicated products.
- Destroying or reconditioning products.
- Decontamination and sanitization of the food production facility(s) that may have processed or was implicated in the adulterated food product(s).
- Supporting facilities that manufacture/process, pack, or hold food for human or animal consumption during the incident.
- Assisting industry in understanding and complying with regulations post-incident.

Under normal conditions, a food incident can be expected to cause only intermittent shortages of the affected product on the store shelves, and not a long-term food shortage. However, panic buying, stockpiling, and hoarding by the public can affect product availability. A food incident may also have cascading effects beyond the direct impacts to industry, including economic losses to related industries, economic losses to surrounding communities, trade restrictions/closures, and public health impacts. For example, if a supply relationship is suspended due to a chemical emergency, the customer will seek other suppliers and regaining lost markets may be difficult due to the newly entrenched competition. Acts of terrorism (threatened or actual) can severely harm agricultural production and domestic agricultural markets by undermining confidence in the safety of the food supply, international export markets, and the economic security of the greater agricultural community. Larger attacks could even threaten the economic stability and national security of the United States. Therefore, economic recovery needs following a chemical food incident may be wide-ranging and could encompass wide swaths of industries associated with food and agriculture activities.

Eliminating any ongoing threats to food and agriculture systems is critical for achieving recovery outcomes.

Figure 69: FDA staff work to protect public health and ensure the safety of the food supply

In many cases, industry will coordinate the decontamination, sanitization, and other remediation actions needed to resume normal business operations as well as immediately reroute supply chains to minimize the effects on demand for the affected commodity. In some cases, however, contamination may be a long-term barrier to continuing activities at that site; for example, an environmentally persistent chemical may remain in soil or sediments for an extended time, preventing crops or fisheries raised there from reaching the market for years to come. However, if the cost of recovery activities and the extent of contamination are high, industry may opt to close a facility or business instead of managing high remediation costs. These decisions may result in the affected business or facility closing, localized economic hardship including job loss and economic losses to associated businesses, and abandoned contaminated facilities that pose a threat to human, animal, and environmental health.

Refer To

Response & Recovery Federal Interagency Operational Plan (FIOP) (December 2021). The FIOP describes integrating and coordinating federal resources and agencies to support SLTT in response and recovery in both Stafford and non-Stafford Act declarations. Initiating recovery early will minimize impacts to affected populations and businesses and assist in returning the food and agriculture sector back to normal business operations to maintain consumer confidence in the US food supply.

National Food and Agriculture Incident Annex (FAIA) to the FIOP (August 2019). The FAIA describes available federal support following food and agriculture chemical incidents; refer also to the Federal Preparedness, Response, and Recovery section of this document.

3. Long-Term Environmental Containment and Site Remediation

While immediate containment and cleanup activities will be initiated during response (as discussed in KPF 4, Control the Spread of Contamination), longer-term, complex remediation strategies may be needed to eliminate or limit the harm of ongoing chemical contamination on a region's environment, critical infrastructure, and population. Containing or eliminating the source of a chemical release can be difficult; detoxifying and remediating contaminated sites can also be challenging. In the best of cases, the chemical may have limited environmental persistence, or the source of the incident may be easily contained. In other cases, complex methods of "treating" (remediating/decontaminating) the environment and contaminated infrastructure may be required (see Appendix H). Unfortunately, some chemical releases are virtually impossible to contain or treat. For example, with the exception of an indoor space, little can be done to contain airborne releases, and "decontamination" efforts are generally restricted to awaiting chemical dilution, dispersion, settling, and decomposition. Clearly, if the contaminant or its toxic reaction products settle onto surfaces, these will later have to be decontaminated. Releases to bodies of water, especially rapidly moving waterways, are often similarly challenging to address.

Refer To

EPA's Contaminated Site Clean-Up Information (CLU-IN) network for technical information and citizen-targeted summaries of technologies used for chemical incident responses.

3.1. Approaches to Site Remediation

Major approaches to site remediation vary depending on the released substance's physical and chemical properties, the release medium (air, soil, sediment, groundwater, or surface water), and situation- and site-specific factors. General options include:[88]

- **Destruction or alteration of contaminants.** Thermal, biological, physical, and chemical treatment methods/destruction technologies can be applied to contaminated media at the release site (in situ) or following removal from the site (ex situ).
- **Extraction or separation of contaminants from environmental media.** Treatment technologies can be used to extract and separate contaminants from soil and groundwater; the removal of chemicals from air is possible, although applications are limited.
- **Immobilization of contaminants.** Immobilization technologies include stabilization/solidification and containment technologies (e.g., booms, neutralizers, sorbents, etc. as described in KPF 4, Control the Spread of Contamination) that reduce the ability of the released substance to move through soil, groundwater, or surface water.

Aspects such as the availability, reliability, costs, and time needed differ for each remediation approach. More details on remediation options are provided in Appendix H.

Figure 70: Remediation of polychlorinated biphenyl (PCB)-contaminated soils and sediments in New Bedford Harbor

3.2. Meeting Established Clearance Goals

As noted in KPF 1, "Prime the Pump" Pre-Event Planning, clearance goals drive recovery costs and timelines to achieving recovery outcomes. Appropriate and reasonable clearance goals should be developed based on pre-incident planning goals and actual incident- and site-specific information. Clearance goals should balance local political and social priorities and public health protection, including the health and safety of responders, against time and cost constraints and concerns for economic recovery and revitalization. For example, clearance goals set to eliminate all risk to public health may result in timelines and costs that are untenable for the community.

Meeting clearance goals may be challenging. For example, as discussed in KPF 2, Recognize and Characterize the Incident, some chemicals penetrate materials more deeply than others, and some persist in the environment longer than others. The recovery process and the time needed to reach "full" recovery – that is, meet clearance goals – may therefore be vastly different for different chemical types. In addition, the availability of containment and remediation resources (materials and equipment) is often limited, as are the specially trained personnel required to operate/use them. Lack of needed resources could affect recovery timelines, especially for large-scale or highly toxic releases. Moreover, challenges associated with contaminated waste management (discussed below) and contaminated remains handling (see KPF 6, Augment Provision of Health and Medical Services to Affected Populations) may affect remediation timelines. Finally, documentation of meeting clearance goals relies on environmental sampling to verify that the area has indeed been remediated; there may be situational issues that affect the efficiency or availability of the sampling and analysis methods used to monitor containment and treatment performance.

Action Item

Develop flexible pre-incident clearance goals specific to local chemical incident risks that balance community priorities. Revisit clearance goals periodically to ensure they reflect the risk tolerance of the population over time.

4. Anticipate Waste Management Challenges

Following a large-scale release of a toxic chemical, response and recovery operations will likely generate very large quantities of both hazardous and non-hazardous waste, depending on the release media and the chemical type. This volume of waste is created by materials directly contaminated with the substance itself as well as environmental remediation and personal and equipment decontamination activities. Waste minimization strategies that focus on recycling, reuse, and reclamation should be considered whenever possible to reduce the waste management burden. While such options will have initial costs, the benefit in terms of elimination of future potential liability is often worth these added costs.[52]

Management of large quantities of hazardous waste may prove challenging, especially when the waste contains evidence (e.g., in suspected or confirmed intentional incidents), and may further drain resources already taxed by other response and recovery efforts. The treatment, storage, handling, transportation, and disposal of waste materials is subject to a variety of local, regional, and national laws, regulations and ordinances (see below). Most urban area landfills and disposal sites do not have the proper permitting to handle chemically contaminated waste, and their waste transportation systems are not equipped to handle the types and quantities of waste generated by chemical incident response and remediation activities. The lack of local capability could significantly expand the recovery timeline if planners have not already considered alternatives for waste management needs (including transportation), as discussed in KPF 1, "Prime the Pump" Pre-Event Planning.

Permanent disposal options for hazardous waste include recycling; physical, chemical or biological treatment to render the waste non-hazardous; incineration; and disposal in specially designed landfills (see Appendix H for more information). Even with pre-planning, however, completing arrangements for the permanent disposition of waste materials may require a great deal of time and could delay other aspects of the recovery. Therefore, plans for temporary waste storage should also be explored. Considerations for such options should include the anticipated quantity or volume of waste, especially if it can be considered a hazardous waste; the compatibility of the waste with the storage container in question; whether any odor or vapors may be released into the atmosphere; and any chemical reactions that could take place.[52] Details regarding waste storage and disposal options following oil releases are presented below.

Chemical types can have repercussions on hazardous waste processing and disposal.

Management of large quantities of hazardous waste will prove challenging and further drain resources.

4.1. Planning for Waste Management and Storage

Waste management plans should achieve the following:[52]

- Provide safe working conditions and comply with all applicable laws and regulations

- Minimize the amount of waste generated
- Segregate hazardous and non-hazardous wastes to allow optimum reclamation and disposal of each waste stream
- Minimize the possibility that disposed wastes will cause future environmental problems or require future remediation
- Provide sufficient temporary and interim storage to prevent delays in recovery operations
- Cooperate with local community and government agencies to minimize impacts on local waste disposal facilities
- Handle, store, and transport wastes in appropriate containers/tanks

Storage site, equipment, and method selection should be based on the type and volume of material to be stored, and consider the following factors:[52]

- Storage location and accessibility
- Storage security, including protection from exposure to heat, fire, and weather, and availability of spill prevention, control, and countermeasures
- Storage capacity and duration (days, weeks, or months) required, including ample space for segregation of non-compatible wastes
- Type of material to be stored
- Usage of regulatory-approved and/or performance-oriented containers
- Expected method of disposal
- Storage site emergency response plan

Figure 71: Storage options for hazardous household waste (left), contaminated sediments (middle), and volatile organic compounds (storage tank, right)

4.2. Waste Treatment, Storage, Handling, Transportation, and Disposal Regulations[85]

The disposition of toxic wastes is primarily directed by the Resource Conservation and Recovery Act (RCRA) for solid wastes and hazardous wastes, by the Clean Water Act (CWA) if wastewater is discharged to a Publicly Owned Treatment Works (POTW) or surface water body, or by equivalent state laws (see Appendix C for more information). While most states follow the format of federal RCRA regulations, some, such as California, apply more stringent controls on wastes that are considered hazardous. Depending on the chemical and region involved, the movement of contaminated materials for their treatment, storage, and/or disposal, especially to other regions, may be challenging in the face of laws governing chemical transport.

More specifically, if wastewater or recovered decontamination fluids are to be discharged to a local POTW, the waste stream must meet the pretreatment requirements of the POTW and any other acceptance criteria in the POTW permit. As many POTWs sell sludge residues for land application in agricultural settings, the POTW must be contacted before any decontamination residues are discharged to ensure such discharges meet facility-specific waste acceptance criteria that may be predicated on subsequent uses for sludge. Discharges directly to a surface water body must meet requirements of the National Pollutant Discharge Elimination Program (NPDES), which are site-specific, depending in part on the classification and criteria of the surface water body and characteristics of the wastewater.

The National Response Framework directs the EPA or USCG to respond to inland or coastal releases of hazardous materials, respectively, including chemical warfare agents and toxic industrial chemicals, in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and ESF #10 – Oil and Hazardous Materials Response Annex (see the Federal Preparedness, Response, and Recovery section of this document for more information). In emergency situations, the NCP facilitates streamlining processes to quickly address an incident, including relief from administratively burdensome permitting for processes such as onsite treatment of hazardous wastes removed from a contaminated facility, and relief from regulatory provisions determined to be impracticable during an urgent response to a chemical incident. The NCP also provides waivers to regulatory provisions under specific circumstances.

Coordination Opportunity

Work with local and regional community and government agencies and facility owners to develop agreements and procedures that will leverage the capabilities of a variety of facilities for chemical incident waste treatment and disposal. Developing a broad base of capability support will help ensure that recovery outcomes are not delayed by waste management issues.

Action Item

- Become familiar with local, state, and national waste treatment, storage, handling, transportation, and disposal regulations
- Explore options for temporary hazardous waste storage as well as permanent waste disposal in your area
- Coordinate interstate transportation waivers, if required, for the licensing and transport of contaminated waste across jurisdictions

Refer To

- Resource Conservation and Recovery Act (RCRA)
- Clean Water Act/Oil Pollution Act
- National Pollutant Discharge Elimination Program (NPDES)
- *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP)
- *ESF #10 – Oil and Hazardous Materials Response Annex* for more information about EPA's role in decontamination and clean up. Hazardous materials include chemical, biological, and radiological substances, whether accidentally or intentionally released.

4.3. Oil Spill Waste Management[52]

Following the 2002 Prestige spill off the coast of Spain, almost twice as much waste was collected as oil was spilled - 117,000 tons vs. 63,000 tons. As oil response and recovery operations are rarely conducted near existing waste management facilities, the development of waste management strategies that minimize the amount of waste generated by these activities is of clear importance. Of further importance are the pre-identification, evaluation, and selection of waste management logistical infrastructure (trucks, containers, etc.) and storage and disposal options. Selections will depend on the size of a spill, its location, and local or regional regulatory requirements. In some areas, oil spill wastes are considered "hazardous wastes" and are subject to those regulations.

Figure 72: Waste management following the 2010 Deepwater Horizon Oil Spill

4.3.1. STORAGE OPTIONS

Onshore/near shore

- Earthen, snow, or air (inflatable) berms
- Tanks: livestock, FRAC, oilfield, pillow, etc.
- Drums
- Trash bags, dumpsters

- Dump, tank, or vacuum trucks

Offshore

- Barges or boats with deck tanks
- Skimmer vessels
- Drums
- Towable tanks, tankers

4.3.2. DISPOSAL OPTIONS

Non-oily waste (PPE, sewage, domestic waste)

- Local wastewater treatment plants
- Municipal landfills

Oiled and hazardous waste

- Industrial landfilling
- Open burning
- Portable incineration
- Commercial incineration
- Reprocessing/recycling
- Reclaiming/recycling

Refer To

For additional information on oil spill waste management refer to:

- IPIECA Report Series *Guidelines for Oil Spill Waste Minimization and Management*
- ITOPF Technical Information Paper *Disposal of Oil and Debris*

5. Managing a Complex Chemical Disaster

As discussed in KPF 5, Augment Provision of Mass Care and Human Services to Affected Population, the context in which a chemical incident occurs influences which response and recovery plans are followed. Since a chemical incident can be triggered by another disaster (for example, an earthquake or a hurricane, as described in the Prologue), recovery needs arising from a chemical incident may compound those resulting from an ongoing event. SLTT officials and their partners should explore how existing recovery plans and structures can be modified to support multiple concurrent disasters, such as hurricanes and earthquakes. Modification of existing plans will enable SLTT officials to focus coordination efforts around clear outcomes and goals across disasters, as well as enhance SLTT leaders' ability to pool and target resources for maximum impact. SLTT leaders should review recovery operations plans and consider in particular:[81]

- Developing or modifying existing plans to include defining essential operations, building staff redundancy, and outlining devolution procedures and authorities
- Accounting for increased recovery efforts to address compounded impacts from concurrent incidents, to include:
  - Cross-contamination and operations impacts resulting from infrastructure dependencies and interdependencies
  - Economic impacts, including impacts to non-essential businesses and loss of livelihood in the impacted area
  - Long-term impacts to health and social services, increased use of telemedicine providers, and reduced utilization of medical services for chronic conditions
  - Increased demand for social services and mental and behavioral health resources

Refer To

- *Oil and Chemical Incident Annex* (OCIA) to the *Response & Recovery Federal Interagency Operational Plan* (FIOP) (February 2021)
- *Public Engagement in Recovery Planning*
- *Effective Coordination of Recovery Resources for State, Tribal, Territorial, and Local Incidents (February 2015)*
- Leadership Before, During, and After a Crisis
- Key Planning Factors in this document for Control the Spread of Contamination, Augment Provision of Mass Care and Human Services to the Affected Population, and Augment Provision of Health and Medical Services to the Affected Population for additional but complementary "need to know" considerations

What Will You Need to Know?

- ☐ How will hazardous waste be processed?
- How will you determine if there are any workforce, resource and/or logistical issues?
- Will any special permits be required?
- ☐ What are the laws regarding transportation of chemical substances in your region?
- What entities are available to transport chemical substances in your region?
- Who will you contact?
- ☐ Where are the contaminated waste treatment facilities in your region?
- Who oversees them?

- What are their capacities?
- How will you know if they are about to reach their capacities?
- Who is authorized to transport contaminated waste?

How will you support the recovery of critical infrastructures and facilities?

Federal Preparedness, Response, and Recovery

As in any disaster, chemical incident response and recovery efforts may require more resources and capabilities than are locally available. Federal resources are activated via a tiered system that extends assistance to meet the local need for events that range from minor incidents to those with catastrophic impacts. Significant chemical incidents may trigger a Presidential Disaster Declaration under the Stafford Act, resulting in the release of significant federal funding for response and recovery activities.

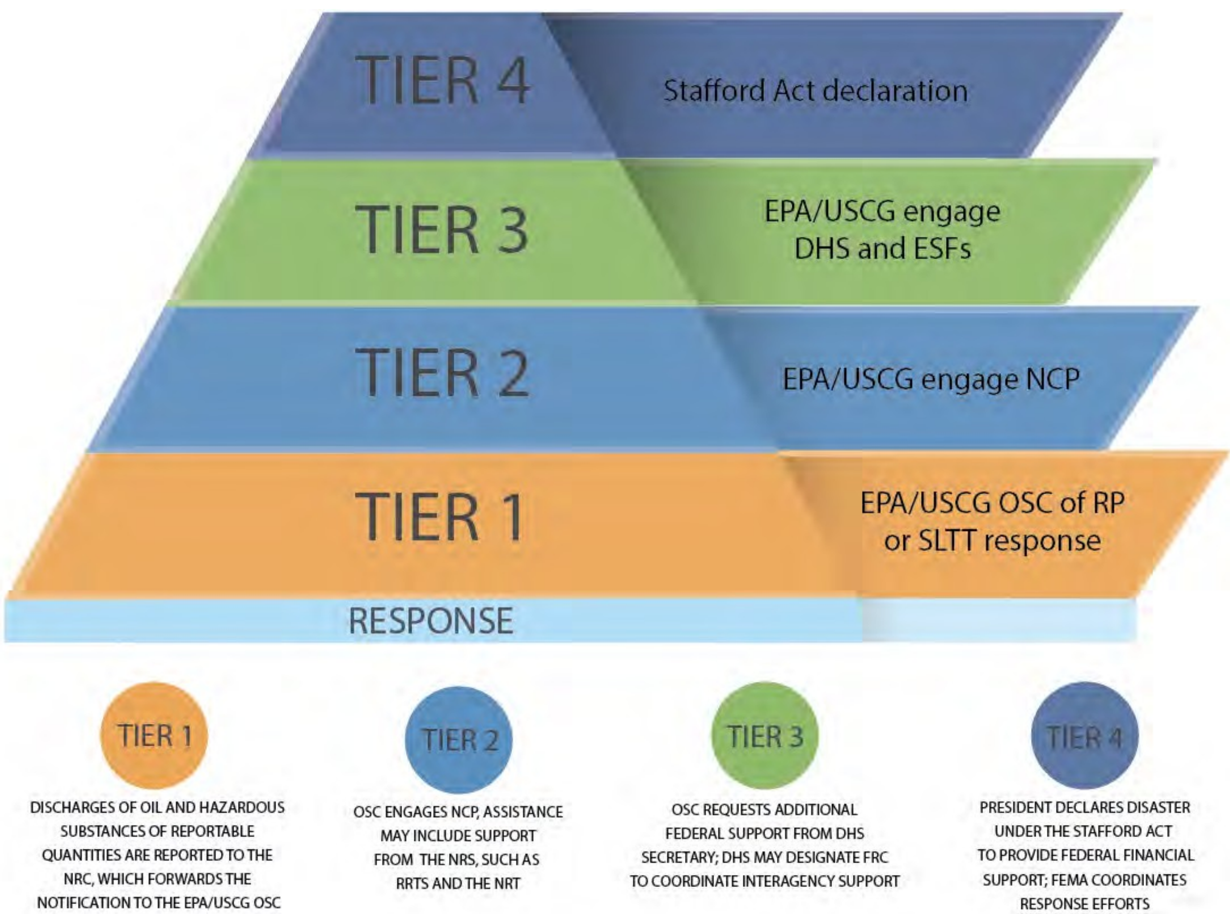
Most chemical incidents can be effectively addressed with resources from the Responsible Party (RP) and state, local, tribal, and territorial (SLTT) authorities. However, a tiered system of federal response assistance is available when the scale of the incident exceeds the response capabilities of local entities and/or a federal On Scene Coordinator determines that additional federal capabilities and resources are required to address the incident.

1. Federal Support for the Response to Chemical Incidents

As depicted on the following page and described briefly here, there are four escalating tiers of federal response to chemical incidents, which scale based on the size and complexity of the incident and the extent of its impact. The Environmental Protection Agency (EPA) or US Coast Guard (USCG) On-Scene Coordinator (OSC) will initiate a preliminary assessment to determine the degree of federal support necessary. The lowest tier of federal involvement in chemical incident response is OSC surveillance of Responsible Party response efforts (the RP is the owner/ operator of the involved vessel or facility). If the OSC determines federal assistance beyond surveillance of Responsible Party activities is required, the OSC will escalate the response to the second tier of federal involvement. The second tier treats the incident as a National Oil and Hazardous Substances Pollution Contingency Plan (NCP) incident, engaging components of the National Response System (NRS).

The NCP defines which agency takes the lead in the incident response and is responsible for providing the OSC and planning and implementing response actions; the lead agency varies depending upon the nature of the event. If more federal resources are required, beyond the scope of the NCP, the OSC may request Department of Homeland Security (DHS) assistance in coordinating Emergency Support Function (ESF) response capabilities and additional federal agency support. If the incident requires federal support beyond the NCP and ESF capabilities, the President may make a Presidential Disaster Declaration under the Stafford Act. Each of these tiers is discussed in further detail in the following section. For more information about the doctrine that underpins the tiered response, see Appendix C, and for more information about ESF response capabilities, see Appendix F.

Figure 73: Four rail cars containing hazardous materials derailed in Graniteville, SC in January 2005. The National Response Center (NRC) notified the EPA OSC, initiating Tier 1 response activities.



The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Clean Water Act (CWA) require oil discharges and releases of reportable quantities of listed hazardous substances be reported to the National Response Center (NRC). The NRC forwards these notifications to the pre-designated EPA or USCG OSC based on the nature of the discharge or release. The OSC then either allows the RP or SLTT entities to conduct response activities with OSC surveillance or determines that the discharge is a substantial threat to public health or welfare and elevates the response to a higher tier, thus engaging the federal government in the response efforts.

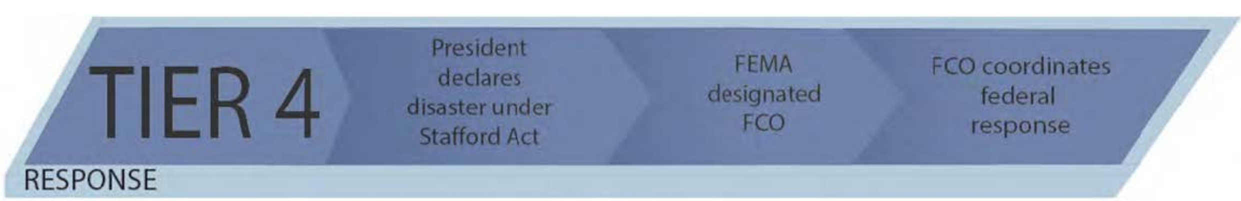
Figure 74: An EPA OSC supervised the Tennessee Valley Authority's (TVA) Tier 1 response to the Kingston Ash slide

When the OSC determines federal NCP response capabilities are necessary, components of the NRS may support the response, which includes the Regional Response Teams (RRTs) and National Response Teams (NRTs). For example, if the OSC determines the incident is a spill of national significance (SONS), the incident response must be led by the federal government. In case of a SONS, the EPA OSC or USCG Commandant may designate an officer/commander to assist them in communication and coordination activities. If the OSC is from the EPA, a Senior Agency Official (SAO) is named; if the OSC is from the USCG, a National Incident Commander (NIC) is named. The NIC and SAO do not replace the OSC, but rather support them. Historically, the majority of chemical release responses that have received federal assistance have remained within the second tier of response and have been conducted within the scope of the NCP, led by the EPA or USCG.

Figure 75: The Tier 2 response to the Exxon Valdez oil spill in 1989 included both RRT and NRT efforts. The President denied multiple requests to declare an emergency under the Stafford Act.

When the incident requires federal resources beyond the scope of NCP support, the OSC may call for additional assistance from the DHS Secretary. This typically occurs in response to a request from SLTT authorities. In response, DHS may designate a Federal Response Coordinator (FRC) who is responsible for coordinating support through interagency agreements, namely the ESFs. ESFs are mechanisms for grouping functions frequently used to provide federal support to states, as well as federal-to-federal support.

Figure 76: Response to the Deepwater Horizon oil spill in 2010 was a Tier 3 interagency effort



The President may make a Disaster Declaration under the Stafford Act when the incident has catastrophic consequences. Such declaration enables the federal government to financially support response, recovery, and mitigation efforts. FEMA is the lead agency for activities carried out under the auspices of the Stafford Act and designates a Federal Coordinating Officer (FCO) to coordinate the federal response. Components of the federal response under a Stafford Act declaration are described in detail in the Response & Recovery Federal Interagency Operational Plan (FIOP) and its Oil and Chemical Incident Annex (OCIA). Historically, very few chemical incidents have involved a Stafford Act declaration.

Figure 77: In 2003, an ammonium nitrate explosion at a West Fertilizer Company facility caused heavy damage as well as a 2.1-magnitude tremor. An emergency declaration came two days after the initial event, elevating the response to Tier 4.

Refer To

- National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Overview
- Response & Recovery Federal Interagency Operational Plan (FIOP) (August 2016)
- *Oil and Chemical Incident Annex* (OCIA) to the Response & Recovery Federal Interagency Operational Plan (FIOP) (February 2021)

1.1. Federal Interagency Coordination

The federal interagency can contribute personnel, resources, and other support to assist as well as coordinate a large-scale (multi-state) response.

As needed for tier 3 and 4 responses, the lead agency will request liaisons from supporting agencies or set up joint systems to facilitate quick responses to information requests. Supporting agencies may lead responses targeted to specific sector impacts; for example, HHS, FDA, and USDA would be responsible for mitigating the impacts of chemical incidents in the public, animal, and plant health sectors.

Supporting agencies will organize under the National Incident Management System (NIMS) for common terminology and ESFs for efficient resource management. FEMA provides operational assistance for coordination between the lead agency, regional staff, and state and local agencies, as necessary. In non-Stafford Act incidents, FEMA's coordination efforts are led by the FRC; in Stafford Act incidents they are led by the FCO.

Refer To

National Incident Management System (NIMS) (October 2017)

1.2. Unified Coordination Group (UCG)

When a disaster is declared, the leadership of agencies with relevant functional authorities may join together in a team effort to respond, forming a Unified Coordination Group (UCG). Unlike other federal coordination efforts, the UCG includes federal and state emergency management officials as well as senior officials from other agencies and organizations (including non-governmental organizations) that have primary statutory jurisdictional responsibility, and/or significant operational responsibility for one or more functions of an incident response. For instance, in the event of an intentional chemical attack, the UCG may include environmental protection, public health, and law enforcement agencies at both the federal and state levels during both the response and recovery phases.

Coordination Opportunity

Depending on the scale of the incident, federal involvement varies, but can be extensive. When ESFs are engaged (Tiers 3 and 4), stakeholders will collaborate closely with on-scene responders at unified command posts, joint field offices, and multi-agency coordination centers.

1.3. Additional National Support Mechanisms: The National Guard

In addition to their ability to request additional response assistance via a Presidential Disaster Declaration under the Stafford Act, state governors can request assistance from their state's National Guard (NG), including the NG's Weapons of Mass Destruction (WMD) Civil Support Teams (CSTs). WMD-CST assistance to civil authorities at a chemical incident site may come in many forms, such as identification of agents/substances, assessment of current or projected consequences, advice on response measures, and assistance with requests for follow-on state and federal military resources.

1.4. Relevant Legislation and Doctrine

In addition to what has already been discussed, federal response and recovery activities in the wake of chemical incidents are governed by numerous additional doctrines and legislation. These are described in Appendix C.

1.5. Law Enforcement/Investigative Response for Suspected Deliberate Incidents

Most chemical incidents are unintentional, such as accidental spills and leaks from storage vessels, transportation accidents, manufacturing process errors, and equipment malfunctions. In situations where the chemical incident is suspected to be the result of an act of terrorism, the Federal Bureau of Investigation (FBI) leads on-scene coordination, as well as the appropriate federal law enforcement response, including intelligence collection operational activities, and criminal investigations For chemical incidents involving other forms of deliberate criminal activity, the FBI may lead or support SLTT on-scene coordination and law enforcement activities; depending on the nature of the incident, capabilities of SLTT authorities, and triggering of relevant Federal authorities. Law enforcement and investigative operations at the national level are coordinated by the FBI-led Weapons of Mass Destruction Strategic Group (WMDSG), an interagency crisis action team. The WMDSG includes a FEMA-led Consequence Management Coordination Unit (CMCU) which ensures information is shared and coordinated across the Response, Protection, Prevention, Mitigation, and Recovery mission areas.

Figure 78: FBI Weapons of Mass Destruction (WMD) training, Seattle 2015

1.6. Federal Funding for Response and Recovery

Responsibilities for funding activities occurring in the aftermath of a chemical incident vary based on the nature, scope, and complexity of the incident, and the degree of federal involvement. The federal funding sources vary depending on whether a disaster is declared under the Stafford Act.

Most incidents are addressed without Stafford Act funding. In these cases, federal financial support is available as described in the NRF Financial Support Annex. Non- Stafford Act funding comes from a variety of sources, such as RPs, the EPA, agency- appropriated funds, and NCP funding sources, depending on the specifics of the scenario.

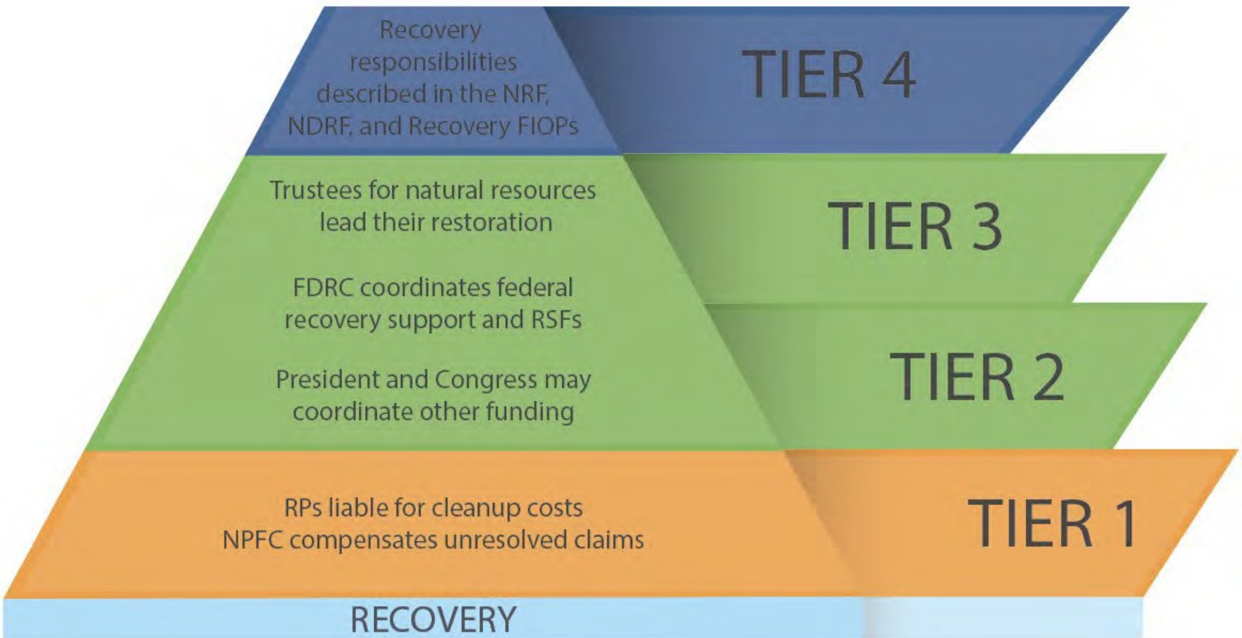
When a disaster is declared under the Stafford Act, FEMA is responsible for coordinating resource delivery to states and localities. For more information regarding federal funding in response to chemical incidents, see Appendix E.

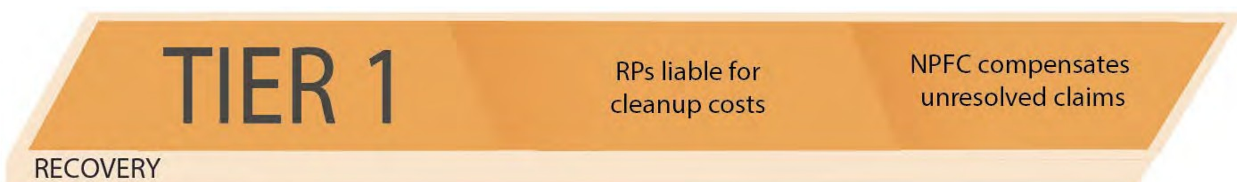
Refer To

National Response Framework (NRF) *Financial Management Support Annex*

2. Federal Support for Recovery Following Chemical Incidents

Just as there are several escalating tiers of federal assistance available to support response to chemical incidents, there are also several escalating tiers of federal assistance available to support recovery efforts. Each of these tiers is briefly described below.



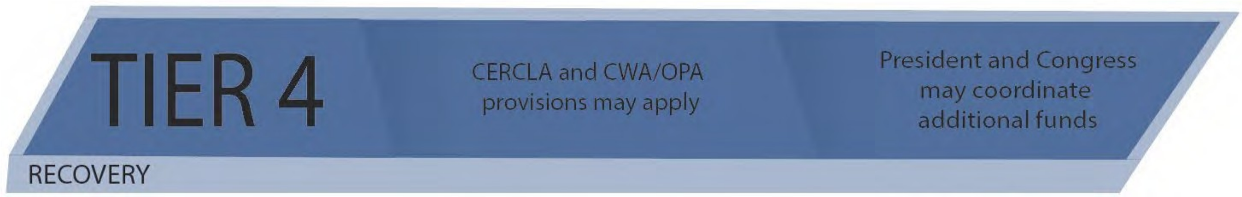


Under CERCLA and the Clean Water Act/Oil Pollution Act (CWA/OPA)[2], RPs are liable for the cleanup costs of chemical releases or discharges. Under OPA, the National Pollution Funds Center (NPFC) administers natural resource damage assessment/restoration claims to recover unresolved compensation claims for public and private entities.

Under the NCP, the EPA or USCG OSC leads chemical incident response activities, while Natural Resource Trustees (Federal, State, and Tribal entities authorized to act on behalf of the public) lead natural resource[3] damage assessment and restoration work. This effort may be coordinated by an intergovernmental trustee council that includes state and tribal members. Additionally, for NCP incidents, a Federal Disaster Recovery Coordinator (FDRC) may be designated to coordinate federal

2 The OPA amended the CWA in 1990 to require oil storage facilities to prepare Facility Response Plans (FRPs).
3 The NCP defines natural resources as land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources.

Recovery Support Functions (RSFs)[4]. The President and Congress can take additional action to establish specific coordinating mechanisms and funds to address recovery outcomes from significant NCP incidents.



Recovery actions taken under the Stafford Act in the wake of chemical incidents may be conducted as described in the National Response Framework (NRF), National Disaster Recovery Framework (NDRF), and Response & Recovery FIOP. The recovery-related provisions of CERCLA and CWA/OPA may also be applicable to chemical incidents. The President and Congress can establish specific coordinating mechanisms and funds to address recovery outcomes from significant Stafford Act incidents. FEMA coordinates the technical and logistical support provided by involved agencies at all levels.

Refer To

- *National Response Framework* (NRF) (October 2019)
- *National Disaster Recovery Framework* (NDRF) (June 2016)
- Response & Recovery Federal Interagency Operational Plan (FIOP) (August 2016)

3. Federal Response to and Recovery from Food and Agriculture Impacts of Chemical Incidents

In the food and agriculture sectors, the most harmful chemical incidents are likely to result in food contamination, while chemical incidents affecting livestock and crops directly are likely to cause limited damage. Regulatory agencies have worked closely with industry to promote a food defense posture that minimizes food supply threats and the risk of accidental or intentional food adulteration. As a result, strong collaborative partnerships between federal, SLTT, academic, and industry entities can be leveraged for targeted response and recovery activities during food incidents. In fact, the lead federal agency (LFA) for the response/recovery to food and agriculture incidents varies depending on the nature of the incident and its impacts (see below), with other agencies serving in supporting roles.

[4] The RSF Leadership Group (RSFLG), composed of leaders at over 25 federal agencies, can facilitate additional coordination for recovery. For example, the Infrastructure RSF has benefited from a MOU between FEMA and EPA requiring coordination between Water State Revolving Funds and Public Assistance (https://www.epa.gov/cwsrf/ memorandum-understanding-between-environmental-protection-agency-and-department-homeland).

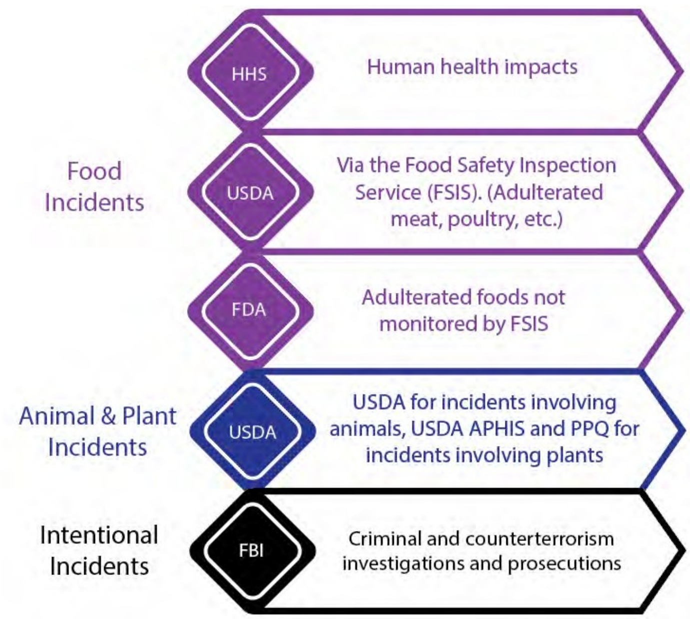


Figure 79: LFAs for various chemical incidents involving food and agriculture

The LFAs for food contamination events do not direct the response and recovery to the broader chemical incidents themselves. For example, if a chemical incident contaminated a food packaging plant, the food contamination LFA would lead the response to the food incident, while the response to the chemical incident itself would be led by a different entity, following the four tiers of chemical incident response described previously.

The coordination structure for food and agricultural incident responses varies depending on the complexity of the incident. The LFA may escalate food incidents to level two or level one response, just as an EPA/USCG OSC may escalate a chemical incident response to tier two or tier three.

Should the President issue a disaster declaration under the Stafford Act for a food or agriculture incident, coordination will occur through the National Response Coordination Center (NRCC) or the Regional Response Coordination Center (RRCC) for the affected jurisdictions. The National Response Framework (NRF) and the NDRF, as well as the FIOP, will serve as guidance for the provision of appropriate federal assistance. The varying coordination structures for non-Stafford Act food incidents are described in the Food and Agriculture Incident Annex (FAIA) to the FIOP.

Refer To

National Food and Agriculture Incident Annex to the Response and Recovery Federal Interagency Operational Plan (FIOP) (August 2019)

What Will You Need to Know?

- ☐ How do various declarations impact planning?
- ▪ Spill of National Significance (SONS)?
- ▪ National Emergency?
- ▪ Stafford Act?
- ☐ How will federal resource availability be determined?
- ☐ What non-federal funding is available?
- ☐ How will you communicate with the lead authorities?
- ▪ The OSC?
- ▪ The NCP?
- ▪ FEMA/DHS?

Planning, Decision Support, and Modeling Resources for Chemical Incidents

Planning for and responding to a chemical incident that is large in scale and/or that involves a particularly hazardous or hard-to-remediate chemical is a daunting and complex challenge. Response plans must be flexible enough to account for a wide range of incident scales, chemicals involved, and response resources available, and expect that contamination of the air or bodies of water will cross jurisdictional boundaries. Numerous resources are available to assist in addressing these challenges, including planning tools, modeling/simulation tools, decision support/response tools, and chemical knowledge databases. The knowledgeable use of these resources is crucial for efficiency and success in preparing for and responding to incidents; they provide a pathway to obtaining the timely data and information that is critical in chemical incident responses.

Pre-planning for every potential chemical release scenario is challenging due to the wide range in scope and magnitude of health and environmental consequence that must be considered. While many facilities storing/housing and using hazardous chemicals are legally obligated to develop specific incident response plans for their facilities and chemical stores, incidents that rise to the level where the facility owner/operator (Responsible Party, RP) requires assistance from local authorities may be complicated by the lack of pre-existing plans specific to the particulars of the incident. During a chemical incident in which uncertainties abound yet actions must be taken quickly to save lives and property, leveraging planning, decision support/response, and modeling/simulation tools provides responders with critical information that can be used to support efficient decision-making and effective response activities. Therefore, the incorporation of response resources and modeling tools into emergency plans is crucial.

Despite the valuable information they can provide, planning, response, and modeling tools have limitations. While some tools are relatively simple to understand and use and can be run quickly at the local level, others are more sophisticated and require more expertise (or access to specialized data sources) than is readily available at the local or regional level. Additional expertise is available through reach-back to federal agencies or subject matter experts (SMEs). Even if not required for tool use, subject matter expertise will add value to understanding tool output; consultation with a SME or SMEs is recommended whenever possible to contextualize the information and ensure accurate interpretations are formulated. Further, the utility and validity of the available tools are constrained by the principles followed during their construction.

Attempts to apply tools to tasks for which they were not designed will generate erroneous and misleading results that will likely lead to poor, potentially dangerous, outcomes; therefore, planners should understand the specific purposes for which each tool was designed. For example, an atmospheric dispersion model may be able to predict the area of hazard downwind of the release of a volatile chemical. However, as the wind shifts and the source of the hazard evaporates, that area may shrink or move. Moreover, since most atmospheric transport models are unable to model the amount of agent removed from the air by precipitation, they are most useful on clear days. In fact, models often do not account for variance in transport, dispersion, and removal mechanisms, including variances such as elevation and vegetation. Additionally, results and outputs are only as good as the input data provided. Planners and responders must understand the data input needs for the models they attempt to use; if timely, appropriate, and accurate input data are not at hand, outputs will be of minimal use (at best) and potentially dangerous (at worst).

This section identifies existing planning, decision support, and modeling capabilities that address the needs of planners and responders. The tables below identify features that will help guide selection of the tool(s) most appropriate for their needs. This list of resources is not comprehensive, but rather intended to provide a starting point for seeking appropriate tools for certain key functions. Of special note is the ChemResponder Network, a whole of community software tool for the collection, management, and sharing of chemical incident and preparedness information, sponsored by the FEMA CBRN Office. Also, keep in mind that federal modeling centers such as the Interagency Modeling and Atmospheric Assessment Center (IMAAC) and National Atmospheric Release Advisory Center (NARAC) can provide access to and assistance with multiple resources. In addition, Appendix A provides a list of databases that provide information relevant to chemical releases. Planners or responders need not be familiar with every resource listed here. Some of the tools and resources provide capabilities that are largely redundant, with only a few distinguishing features. The use of these models is by no means mandatory; however, they have been shown to provide value when applied to the appropriate situations. Prior to an incident, planners should identify which tools are best suited for the scenarios that are most likely in their jurisdiction, which tools are already in use in their jurisdiction, and which tools they are more likely to use, based on their community's needs and material and expertise resources.

Coordination Opportunity

Modeling resource centers such as IMAAC and NARAC often employ an array of tools when responding to information/data requests. For example, IMAAC's modeling suite includes CAMEO, HYSPLIT, HPAC, SHARC, and HAZUS-MH. Thus, a single point of contact can be leveraged for access to multiple models/resources.

Refer To

- *Oil and Chemical Incident Annex* (OCIA) to the *Response & Recovery Federal Interagency Operational Plan* (FIOP) (February 2021)

- *National Food and Agriculture Incident Annex* to the *Response and Recovery Federal Interagency Operational Plan* (FIOP) (August 2019)
- Model and Data Inventory (MoDI) for more information about federal modeling and simulation resources

Action Item

Identify which tools are best suited for the scenarios that are most likely in your jurisdiction, which tools are already in use in your jurisdiction, and which tools you are likely to use

- Familiarize planners and responders with ChemResponder and the CAMEO tool suite
- Know how to contact your WMD-CST
- Know how to contact IMAAC and/or NARAC for more advanced modeling needs

What will you need to know for selection and use of tools and resources?

☐ Why and when will you need modeling and simulation?

- For atmospheric and aquatic dispersion event characterization and consequence analysis?
- For syndromic surveillance?
- For population/persons tracking through facilities and communities (evacuee and relocation analysis)?
- For situational awareness, assessment, and management of resources?
- For location and availability of critical pharmaceuticals and supplies?
- For environmental, agricultural, and wildlife impacts?
- For boundaries for mitigating exposure risk for community members and emergency responders?
- For consequence prediction for Recovery phase (injuries, long-term medical impacts, economic damage, critical infrastructure disruption, etc.)?

☐ How will emergency responders access tools and resources?

- Who will you reach out to for various modeling resources and response tools?
- Which require reach-back support, and which can be run at the local level?
- What tools do emergency responders need prior training on?
- What just-in-time training might responders need? Who will provide it?

☐ What state-level reach-back support is available?

- Will they automatically run models as part of their protocols?

- How will their models be accessed?
- Is there data they will need from you to run their models?
- When will results be available?
- How often will inputs and the models be updated?
- How will the model results be reported and to whom?

☐ What local data sources will provide the latest available information necessary to populate models?

- If current information will not be readily available, what method will you establish to obtain the required information?
- Do you have the necessary pre-established accounts for use of national databases?
- How will you collect accurate and timely local data to populate the selected models?
- Will you have sufficient resources (qualified personnel on staff, appropriate IT infrastructure, etc.) to support running models in-house?

☐ Consider the form and content of selected model outputs:

- Will they be appropriate for your needs?
- Will they be understood by decision makers?
- Are there local subject matter experts who will be available to help clarify the data and advise the decision makers?

☐ Who will interpret the results? Public health officials? Emergency management officials? Incident commanders?

☐ Who will act on the results?

What will you need to know for use of tools and resources during planning?

☐ Select models that are appropriate to estimate the impact of the chemicals of concern

☐ Identify available data sources, collect the most current input data for the selected model(s), and obtain the model results

☐ Run excursions with varying input parameters to get a feel for the variability/sensitivity of the results to uncertainties in the input data

- As more specific data become available, rerun the tools to get more current results

☐ Do you need to exercise model-supported runs of the assumed chemical scenarios?

What will you need to know for use of tools and resources during a response?

☐ How will you detect and characterize a chemical incident?

- What is the anticipated timeline from initial occurrence to detection/recognition of the event?

- ☐ How will you assess availability of medical response supplies (hospital beds, supplies, equipment, medical/public health personnel)?
- ☐ Where will you obtain up-to-date population demographic data?
- ☐ How will you update relevant information?
  - Identify resources for the collection of real-world data
  - How will responders mitigate risk while collecting necessary data inputs?
- ☐ Be prepared to re-run models to guide continued response as the incident progresses and more data becomes available
  - What inputs are required to update modeling?
  - How often do models require new inputs to remain accurate and informative?

Table 3: Planning, Response, and Decision Support Tools—Operations and Response Management

Tool	Capability	Reference for Additional Information
Chemical Biological Response Aide (CoBRA)	CoBRA is a decision support software package for incident response and evidence collection in acontaminated environment. CoBRA can be used to determine if a site poses an immediate hazardand if specialized CBRN assistance is required. CoBRA includes: ▪ General standard operating procedures ▪ A large, searchable CBRNE reference library ▪ Interactive tools to document sites, create reports, and establish stand-off distance and decontamination procedures ▪ Tools for characterization of hazardous material, elimination of weapons of mass destruction,and identification of precautions and avoidance measures	https://gis.fema.gov/Model-and-Data-Inventory/#resource/36?
ChemResponder	ChemResponder is FEMA's application and website for collecting and sharing chemical data duringchemical incidents, including gas meter readings, calorimetric results, observations, and situational reports, to support faster, more accurate incident characterization and lifesaving decisions. ChemResponder is accessible online and via the ChemResponder app.	http://www.chemresponder.net/
Community Lifelines	The Lifelines are FEMA's framework for assessing and organizing incident information to understand and communicate incident impacts and to prioritize response efforts to stabilize critical infrastructure. Specifically, the framework organizes critical infrastructure and fundamental servicesinto seven lifelines: Safety and Security; Food, Water, Shelter; Health and Medical; Energy (Power & Fuel); Communications; Transportation; and Hazardous Materials.	https://www.fema.gov/lifelines
Environmental Response Management Application (ERMA)	The ERMA online mapping tool integrates real-time weather and vessel data feeds with event- specific information about coastal disasters, such as oil or chemical spills, to coordinate National Oceanic and Atmospheric Administration (NOAA) response and recovery efforts. ERMA is used toidentify resources at risk, evaluate response plans, perform natural resource damage assessments, and track restoration activities.	https://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-erma

Tool	Capability	Reference for Additional Information
Environmental SensitivityIndex (ESI)	The ESI map application provides a summary of coastal resources at risk in the event of an oil spill.Resources at risk may include biological resources such as birds and shellfish beds, sensitive shorelines such as marshes and tidal flats, and human-use resources such as public beaches and parks. The tool is valuable for identifying vulnerable locations, establishing protection priorities, and identifying cleanup strategies.	https://response.restoration.noaa.gov/esi
Visual Sample Plan (VSP)	The VSP supports the development of an environmental or building interior sampling plan to determine how many samples are needed, where samples should be taken, and what decisions the sample data support. It supports responses to pollutant or contaminant release events.	https://vsp.pnnl.gov/
Wireless Information System for Emergency Responders (WISER)	WISER is an extensive system designed to assist emergency responders in hazardous materials incidents. It includes substance identification support, chemical and physical properties, human health information, and containment and suppression guidelines, triage protocols, immediate action guidance, etc.	https://wiser.nlm.nih.gov/

Table 4: Planning, Response, and Decision Support Tools—Medical Support Tools

Tool	Capability	Reference for Additional Information
Chemical Hazards Emergency Medical Management (CHEMM)	CHEMM is an HHS website and application that assists first responders, planners, and healthcare providers in planning for, responding to, recovering from, and mitigating the effects of incidents involving chemical releases. The CHEMM resource is extensive and includes: ▪ Initial incident activities: triage guidelines, decontamination procedures, PPE, etc. ▪ Quick chemical identification: links to CHEMM-IST and WISER (described in this table) ▪ Tools, guidelines, and planning: CHEMM toxidrome cards, resource comparisons, key guidance documents, etc.	https://chemm.nlm.nih.gov/

Tool	Capability	Reference for Additional Information
CHEMM Intelligent Syndromes Tool (CHEMMIST)	CHEMM-IST is a prototype decision support tool for identifying which chemical a patient was exposed to in an uncharacterized chemical incident. Tool use requires inputs such as vital signs, mental status, pupil size, mucous membrane irritation, lung exam results, and skin condition.	https://chemm.nlm.nih.gov/chemmist.htm
Chemical Screening Tool for Exposures and Environmental Releases (ChemSTEER)	ChemSTEER software estimates workplace exposures and environmental releases for chemicals manufactured and used in industrial/commercial settings. ChemSTEER also contains data and estimation methods to assess chemical use in common industrial/commercial sectors and chemical functional uses. The tool does not contain methods for estimating exposures to chemicals to the general public, to consumers, or to other species in the environment.	https://www.epa.gov/tsca- screening-tools/chemsteer-chemical-screening-tool-exposures-and-environmental-releases
Dermal Exposure Risk Management and Logic for Emergency Preparedness and Response (DERMaL) eToolkit	This resource library provides references and information related to dermal (skin) exposure to chemicals. The information is conveniently sorted by incident phase. The resource includes a checklist for assessing risks during responses to chemical hazards and contains key questions for risk analyses.	https://chemm.nlm.nih.gov/dermal/index.html
Emergency Responder Health Monitoring and Surveillance (ERHMS)	ERHMS is a health monitoring and surveillance framework to address gaps in surveillance and health monitoring of emergency responders. It provides recommendations, guidelines, tools, and training to protect responders.	https://www.cdc.gov/niosh/erhms/default.html
Rapid Response Registry	This tool helps state and local response entities rapidly establish registries of persons who are exposed or potentially exposed to chemicals or other harmful agents during catastrophic events.	https://www.atsdr.cdc.gov/rapidresponse/

Table 5: Planning, Response, and Decision Support Tools—Resource and Distribution Tracking

Tool	Capability	Reference for Additional Information
NIOSH PPE Tracker App	This mobile app tracks PPE inventory for healthcare and non-healthcare systems, calculating their average PPE consumption rate and estimating how long inventories will last.	https://www.cdc.gov/niosh/ppe/ppeapp.html
RealOpt© Software Enterprise	The RealOpt© suite of software tools is designed to optimize public health infrastructure for all hazard emergency response. The suite of tools includes: ▪ *RealOpt-POD:* Optimizes resource allocation within medical facilities (design point of distribution (POD) floorplans, determine labor requirements, carry out large-scale virtual drills, etc.) ▪ *RealOpt-Regional:* Optimizes large-scale regional medical dispensing and emergency preparedness (locate facilities with medical countermeasures, determine traffic routes to access facilities, etc.) ▪ *RealOpt-RSS:* Optimizes and manages logistics of receipt, stage, and storage (RSS) facilities and regional distribution nodes (RDNs) for medical countermeasures *(Other tools within the RealOpt suite are specifically radiological)*	https://www.realopt.gatech.edu/research.php
Surge Toolkit and Facility Checklist	This step-by-step guide for hospitals expanding surge capacity in response to emergencies includes planning materials for management, legal, facility, staffing, security, materials/resource management, and transportation.	https://www.ahrq.gov/research/shuttered/toolkitchecklist/index.html

Table 6: Modeling/Simulation Resources—General

Tool	Capability	Reference for Additional Information
Chemical City Planner Resource Tool (chemCPR)	When released, the chemCPR tool will provide animations, maps, movies, and reports describing city- specific chemical release scenarios that can be used to develop response plans and exercises. chemCPR outputs will include event progression, injury and casualty analysis, and infrastructure impacts that will help estimate the scale and areas of resource need for each scenario. Additionally, chemCPR's interactive GIS capability will display Homeland Security Infrastructure Program (HSIP) Gold/Homeland Infrastructure Foundation-Level Data (HIFLD) on customizable maps.	Web-based – still in development
Computer-Aided Management of Emergency Operations (CAMEO)	This software suite for planning and responding to chemical emergencies includes tools to access, store, and evaluate critical information. CAMEO includes four applications: ▪ *CAMEOfm*: A database application for tracking information, such as chemical inventories and facility contact information, to assist in emergency response and planning ▪ *CAMEO Chemicals:* A database of hazardous chemicals, listing health hazards, firefighting techniques, cleanup procedures, necessary PPE, etc. ▪ *Mapping Application for Response, Planning, and Local Operational Tasks (MARPLOT):* A mapping application that links to CAMEO*fm* to store facility information and display chemical release scenarios to determine potential impacts and aid decision-making ▪ *Areal Locations of Hazardous Atmospheres (ALOHA):* This atmospheric dispersion model can be used to evaluate releases of hazardous chemical vapors *Jurisdictions should at minimum be familiar with CAMEO*	CAMEOfm: https://www.epa.gov/cameo/cameo-software CAMEO Chemicals: https://cameochemicals.noaa.gov MARPLOT: https://www.epa.gov/cameo/mar plot-software ALOHA: https://www.epa.gov/cameo/aloha-software

Tool	Capability	Reference for Additional Information
Estimation Program Interface (EPI) Suite	EPI Suite is a Windows®-based suite of roughly 17 physical/chemical property and environmental fate estimation programs. Each program has its own unique capabilities, but some examples include: ▪ *ECOSAR™:* Estimates acute and chronic toxicity of industrial chemicals to aquatic organisms ▪ *AOPWIN™:* Estimates the gas-phase reaction rate for the reaction between the most prevalent atmospheric oxidant, hydroxyl radicals, and a chemical ▪ *AEROWIN™:* Estimates the fraction of airborne substance absorbed to airborne particulates	https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface
Exposure and Fate Assessment Screening Tool (E-FAST)	E-FAST provides estimates of the concentrations of chemicals released to air, surface water, landfills, and consumer products, and the potential inhalation, dermal and ingestion dose rates resulting from releases of chemicals. Modeled estimates of concentrations and doses are designed to reasonably overestimate exposures, for use in an exposure assessment in the absence of or with reliable monitoring data.	https://www.epa.gov/tsca-screening-tools/e-fast-exposure-and-fate-assessment-screening-tool-version-2014
GeoHEALTH	This interactive mapping application incorporates information from many federal and public agencies (USCG, HHS, NOAA, etc.) into a single visual environment. GeoHEALTH can display many different datasets and information feeds simultaneously, including local data feeds, enabling users to customize maps with different layers to visualize various features in tandem.	https://geohealth.hhs.gov/arcgis/home/
Interagency Modeling and Atmospheric Assessment Center (IMAAC)	Regardless of the time of day or year, the IMAAC quickly coordinates and disseminates dispersion modeling and hazard prediction products to support response and tactical decision-making during atmospheric and water hazardous materials releases. IMAAC tools include HPAC, QUIC, and SHARC (described in this table), among many others. IMAAC support for exercises and planning is also available.	https://www.fema.gov/emergency-managers/practitioners/hazardous-response-capabilities/imaac

Table 7: Modeling/Simulation Resources—Atmospheric

Tool	Capability	Reference for Additional Information
National Atmospheric Release Advisory Center (NARAC)	NARAC provides 24/7 expertise and tools to predict and map the spread of hazardous material accidentally or intentionally released into the atmosphere. NARAC tools include operational modeling systems, web-based tools, and stand-alone PC-based plume modeling and physical tools, such as EPICode (described in this table).	https://narac.llnl.gov/
Quantitative Structure- Activity Relationship (QSAR) Toolbox	This software application is designed to fill gaps in toxicity data for assessing chemical hazards by accessing large chemical data repositories. Key features include: ▪ Identification of structural characteristics and potential mechanisms or modes of action of target chemical ▪ Identification of chemicals with similar structural characteristics and/or mechanisms or modes of action ▪ Use of experimental data to fill data gaps	https://qsartoolbox.org/
FLEXible Particle Dispersion Model (FLEXPART)	This dispersion model simulates atmospheric transport and dispersion, and is capable of modeling transport and turbulent diffusion, wet and dry deposition, decay, and linear chemistry.	http://www.flexpart.eu/
Hazard Prediction & Assessment Capability (HPAC)	HPAC is a forward deployable, probabilistic chemical hazard prediction model that assists responders in analyzing chemical weapons of mass destruction (WMD) employment. *Jurisdictions with appropriate support capabilities can request HPAC software from DTRA. Use of HPAC is also available by request via the Interagency Modeling and Atmospheric Assessment Center (IMAAC) and by contacting your state's WMD-CST Team.*	https://gis.fema.gov/Model-and-Data-Inventory/#resource/130?
Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT)	HYSPLIT is a complete system for computing simple air parcel trajectories as well as complex atmospheric transport, dispersion, chemical transformation, and pollutant deposition simulations.	https://www.arl.noaa.gov/hysplit/hysplit/

Tool	Capability	Reference for Additional Information
Emergency Prediction Information Code (EPICode)	EPICode provides rapid modeling to estimate downwind concentrations of chemicals (gas, vapor, or aerosol) released during industrial and transportation accidents.	https://narac.llnl.gov/tools/hotspot-epicode
Chemical Aquatic Fate and Effects (CAFE) Database	CAFE is a software program for estimating the fate and effects of thousands of chemicals, oils, and dispersants in water. It presents data in two modules: ▪ *Aquatic Fate Module:* Provides the structure, physical properties, and environmental fate of pollutants ▪ *Aquatic Effects Module:* Produces Species Sensitivity Distribution (SSD) models that describe acute effects for various exposure times to a specific pollutant, for a given species	https://response.restoration.noaa.gov/oil-and-chemical-spills/chemical-spills/response-tools/cafe.html

Table 8: Modeling/Simulation Resources—Aquatic

Tool	Capability	Reference for Additional Information
General NOAA Operational Modeling Environment (GNOME)	The GNOME predicts possible routes/trajectories of pollutants in bodies of water, such as oil spills. Outputs include: ▪ Weathering predictions, regarding how pollutants may chemically and physically change over time ▪ Animations of predicted pollutant trajectories ▪ Estimations for the amount of pollutant beached, floating, and evaporated over time	https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/gnome.html

Tool	Capability	Reference for Additional Information
Incident Command Tool for Protecting Drinking Water (ICWater)	ICWater is an operational emergency response system for modeling spills in surface waters. It provides time-of-travel and concentration values using real-time water flow data and external database information.	https://gis.fema.gov/Model-and-Data-Inventory/#resource/144?
System for Hazard Assessment of Released Chemicals (SHARC)	SHARC predicts the trajectory and fate of weaponized chemical agents, toxic industrial chemicals, and oil transport in an aquatic environment. *Use of this model is available by request via the Interagency Modeling and Atmospheric Assessment Center (IMAAC).*	https://ual.geoplatform.gov/api/items/802683f46eb3f68bd95aa04efdc11101.html

Table 9: Modeling/Simulation Resources—Urban/Structural

Tool	Capability	Reference for Additional Information
Aeolus	Aeolus simulates high-resolution flow and dispersion of hazardous material in urban areas and complex terrain environments. The model has been used to develop emergency response planning guidance and is targeted for use in NARAC operational emergency response applications. *Use of this model is available by request via the National Atmospheric Release Advisory Center (NARAC).*	https://narac.llnl.gov/research-and-development/urban-dispersion-modeling
CONTAM	CONTAM is an indoor air quality and ventilation analysis program that is used to characterize the dispersion of airborne contaminants through an indoor space. It predicts airflows, contaminant concentrations, and occupant exposures.	https://www.nist.gov/services-resources/software/contam

Tool	Capability	Reference for Additional Information
CT-Analyst	CT-Analyst provides accurate, instantaneous, 3D predictions of chemical agent transport in urban settings based on detailed urban aerodynamics computations.	https://www.nrl.navy.mil/lcp/ct-analyst
Integrated Indoor-Outdoor Air Calculator (IIOAC)	This user-friendly, Excel-based tool estimates indoor and outdoor air concentrations and particle deposition at different distances from sources that release chemical substances to the air. It quickly estimates air concentrations from multiple sources and multiple air releases using pre-run results from a suite of Air Quality Dispersion Modeling (AERMOD) scenarios.	https://www.epa.gov/tsca-screening-tools/iioac-integrated-indoor-outdoor-air-calculator
Quick Urban & Industrial Complex (QUIC) Dispersion Modeling System	QUIC is a fast response urban dispersion model that computes chemical, biological, and radiological agent dispersion on building to neighborhood scales in tens of seconds to tens of minutes. This model predicts the above ground airborne spread of chemical agent, accounting for the effects of individual buildings, in a downtown area. *Use of this model is available by request via the Interagency Modeling and Atmospheric Assessment Center (IMAAC).*	https://www.lanl.gov/projects/quic/

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Appendix A. Chemical Substances and Hazard Information Resources

Table 10: Chemical Substances and Hazard Information Resources

Asset	Description	Agency/Owner
Acute Exposure Guideline Levels (AEGLs)	Chemical concentration levels of airborne chemicals that cause health effects. Search by chemical name or CAS number.	EPA
Chemical Agents Database	A list of hazardous chemicals providing case definitions, toxicological profiles, medical management guidelines, emergency response cards, etc.	CDC
Chemical Quick Reference Guides (QRGs)	Reference guides for various hazardous chemicals, detailing chemical characteristics (classification, description, solubility, etc.), probable release scenarios, health effects, AEGLs, personnel safety measures (PPE, first aid, and medical info), field detection methods for various equipment, sampling guidance, decontamination/cleanup information, and waste management techniques.	NRT
Chemical Transportation Emergency Center (CHEMTREC®)	CHEMTREC® is a public service hotline for emergency responders, providing timely information during chemical and hazardous materials incidents.	American Chemistry Council
CompTox Chemicals Dashboard	Searchable by chemical, product/use category, and assay/gene. Provides properties, hazards, safety, exposure, and bioactivity information. Also links to relevant literature.	EPA
Emergency Response Guidebook (ERG)	The ERG (updated in 2020) is a guidebook for first responders to use during the initial phase of transportation incidents involving dangerous goods and hazardous materials.	DOT
Emergency Response Safety and Health Database (ERSH-DB)	This NIOSH database contains accurate and concise information on high-priority chemical, biological and radiological agents that could be encountered by personnel responding to a terrorist event.	NIOSH
Envirofacts	A single point of access to US EPA data, providing access to several EPA databases on one platform.	EPA

Asset	Description	Agency/Owner
Health Effects Notebook for Hazardous Air Pollutants (HAPs)	A collection of HAP fact sheets detailing health impacts. Includes volatile organic chemicals, pesticides, herbicides, and radionuclides.	EPA
Integrated Risk Information System (IRIS)	An EPA assessment tool/database of assessments that identify and characterize health hazards of chemicals found in the environment, be it a single chemical, group of chemicals, or complex mixture.	EPA
International Chemical Safety Cards (ICSCs)	A platform for searching the ICSC database, which provides chemical information including acute hazards, prevention, firefighting, first aid, symptoms, spillage disposal, storage, packaging information, etc.	International Labour Organization
NIOSH Immediately Dangerous to Life or Health (ILDH) Values	List of IDLH values.	CDC/NIOSH
NIOSH Pocket Guide to Chemical Hazards (mNPG)	Provides chemical-specific data to supplement general industrial hygiene knowledge.	CDC/NIOSH
NIOSH PPE Information (PPE- Info)	A compendium of federal regulations and consensus standards for Personal Protective Equipment (PPE)— allows general or advanced criteria searches of relevant federal standards, associated product types, target occupational groups, basic conformity assessment specifications, and accredited lab information.	CDC/NIOSH
Occupational Health Guidelines for Chemical Hazards	NIOSH’s guidelines for chemical hazards. Lists chemical properties, identifiers, exposure limits, routes of exposure, health effects, symptoms of exposure, and emergency procedures.	CDC/NIOSH
OSHA Occupational Chemical Database	Inventory of occupational chemical information, including identification, physical properties, exposure limits, sampling information, permissible exposure limits (PELs), and short-term exposure limits (STELs).	OSHA
PubChem	Searchable by chemical name, molecular formula, structure, and other identifiers. Provides chemical and physical properties, biological activities, safety and toxicity information, patents, literature citations, etc.	NCBI

Asset	Description	Agency/Owner
Wireless Information System for Emergency Responders (WISER)	WISER provides a wide range of hazardous substances information, including substance identification support, physical characteristics, human health information, containment guidance, and suppression advice.	US National Library of Medicine
Substance Registry Services (SRS)	EPA's central system for information about substances that are tracked or regulated by the EPA.	EPA
Toxicity Forecaster (ToxCast) Chemicals	Chemical library that includes properties, risk assessment, hazard values, exposure estimates, fate and transport data, links to related research, etc. for each chemical.	EPA
Toxicological Profiles	A compilation of toxicological information on hazardous substances. Focuses on health effects and public health concerns, but also provides chemical and physical information; product, import, use, and disposal information; regulations and advisories; etc.	ATSDR
Water Contaminant Information Tool (WCIT)	Comprehensive information about chemical, biological, and radiological contaminants of concern for water security.	EPA

Appendix B. Health Effects of Chemical Exposure: Toxidromes

Human exposure to many chemicals can be hazardous and have mild to severe toxic effects. Syndromes caused by exposure to dangerous levels of toxins are referred to as toxidromes, a portmanteau of toxic and syndrome. Toxidromes are groups of signs and symptoms used to diagnose poisoning, typically grouped by clinical presentations and their countermeasures/treatments. Understanding toxidromes is valuable for identifying effective treatments and appropriate PPE based on clinical observations when specific chemical/source information is unavailable. A brief overview of nine common toxidromes, as defined by the Department of Homeland Security and National Library of Medicine[5], are presented below.

[5] Report on the Toxic Chemical Syndrome Definitions and Nomenclature Workshop. https://chemm.nlm.nih.gov/Report_from_Toxic_Syndrome_Workshop_final.pdf

Table 11: Chemical Toxidromes

Toxidrome Category	Clinical Presentations	Mechanism	Causative Chemicals	Common Antidotes and Treatment Protocols
Solvents, Anesthetics, or Sedatives (SAS)/ Organic Solvents Toxidrome	Central nervous system (CNS) agitation or depression Behavioral changes ▪ Slurred speech ▪ Abnormal eye movements (nystagmus) ▪ Ataxia (difficulty walking/ balancing) ▪ Chemical burns ▪ Loss of consciousness ▪ Coma ▪ Convulsions ▪ Respiratory arrest ▪ Cardiac dysrhythmia (irregular heartbeat) ▪ Cardiac arrest	▪ Catecholamine release ▪ GABA receptor effects ▪ Ion channel effects in the brain	▪ Gasoline ▪ Benzene ▪ Nitrous oxide ▪ Barbiturates ▪ Methylene chloride ▪ Benzodiazepines	▪ Artificial ventilation ▪ Flumazenil
Anticholinergic Toxidrome	▪ Blurred vision ▪ Confusion ▪ Hallucinations ▪ Coma ▪ Pupil dilation (mydriasis) ▪ Increased body temperature ▪ Increased pulse ▪ Decreased sweating	Under-stimulation of cholinergic nerve receptors leading to central nervous system and respiratory system depression	▪ Atropine ▪ Cogentin ▪ BZ (3-quinuclidinyl benzilate) ▪ Hyoscyamine ▪ Scopolamine	▪ Physostigmine ▪ Benzodiazepines

Toxidrome Category	Clinical Presentations	Mechanism	Causative Chemicals	Common Antidotes and Treatment Protocols
Anticoagulant Toxidrome	▪ Abnormal bleeding ▪ Lethargy ▪ Pallor	Altered blood coagulation	▪ Superwarfarins ▪ Coumadin	▪ Fresh frozen plasma ▪ Whole blood and Factor VII therapy ▪ Vitamin K1
Cholinergic/ Pesticide/Nerve Agent Toxidrome	▪ Pinpoint pupils (miosis) Seizures ▪ Wheezes Twitches ▪ Excessive secretion (sweat, tears, saliva, vomit, incontinence, etc.) ▪ SLUDGE[6] ▪ DUMBBELS[7] ▪ Systemic gastrointestinal and central nervous system effects progressing to death if untreated	Over-stimulation of cholinergic nerve receptors	▪ Nerve agents (e.g., GB/sarin, GA/tabun, GD/soman, and VX) ▪ Organophosphorus pesticides ▪ Carbamate pesticides ▪ Fourth Generation Agents (FGAs) (e.g., novichoks)	▪ Atropine ▪ 2-PAM (oximes) ▪ Benzodiazepines ▪ Artificial ventilation ▪ Scopolamine ▪ Ketamine
Convulsant Toxidrome	▪ Convulsions, can be fatal when severe	Central nervous system excitation; glycine, GABA, or glutamate antagonism	▪ Strychnine ▪ TETS[8] ▪ Picrotoxin ▪ Phenylsilatrane	▪ Benzodiazepines ▪ Barbiturates ▪ Pyridoxine

[6] Salivation, Lacrimation (flow of tears), Urination, Defecation, Gastrointestinal Distress, and Emesis (vomiting)
[7] Diarrhea, Urination, Muscles weakness/Miosis (pupil constriction), Bronchorrhea (excessive mucus, often resulting in phlegmy coughs), Bradycardia (slow heart rate), Emesis, Lacrimation, Salivation/Sweating
[8] Tetramethylenedisulfotetramine

Toxidrome Category	Clinical Presentations	Mechanism	Causative Chemicals	Common Antidotes and Treatment Protocols
Irritant/Corrosive Toxidrome	▪ Irritation of exposed skin and mucous membranes ▪ Coughs ▪ Wheezes ▪ Respiratory distress ▪ Gastrointestinal effects ▪ Blistering and burns ▪ Tearing/lacrimation	Irritating properties produce blisters on the skin and/or damage to the eyes, lung, and other mucous membranes	▪ Blister agents/ vesicants ▪ Mustard agents ▪ Lewisite ▪ Choking/pulmonary agents ▪ Ammonia ▪ Phosgene ▪ Chlorine ▪ Riot Control Agents (RCAs)	▪ Ingestion: Anti-emetics, activated charcoal ▪ Inhalation: Oxygen, bronchodilators, corticosteroids, artificial ventilation, sodium bicarbonate ▪ Topical: Flushing, oxygen, pain medication
Knockdown/ Asphyxiant/Blood Agent/Metabolic Toxidrome	▪ Confusion ▪ Fatigue ▪ Lightheadedness ▪ Seizures ▪ Coma ▪ Loss of consciousness ▪ Cardiac arrest ▪ Gastrointestinal effects ▪ Hair, nail, kidney, and neurological abnormalities	Disrupted oxygen delivery to tissues Interference with intracellular processes leading to multiple organ failure	▪ Carbon monoxide ▪ Cyanide ▪ Aluminum phosphide ▪ Cyanogen chloride (CK) ▪ Arsenic ▪ Mercury ▪ Thallium	▪ Cyanokit (cyanide) ▪ Sodium nitrite/sodium thiosulfate kit (cyanide) ▪ Oxygen ▪ Prussian Blue (thallium) ▪ Chelators, BAL or DMSA[9] (arsenic)

[9] British Anti-Lewisite (BAL) and Dimocaptosuccinic Acid (DMSA), also called succimer

Toxidrome Category	Clinical Presentations	Mechanism	Causative Chemicals	Common Antidotes and Treatment Protocols
Opioid Toxidrome	▪ Pinpoint pupils (miosis) ▪ Decreased pulse and blood pressure ▪ Decreased temperature ▪ Decreased digestion ▪ Respiratory failure	Opioid receptor agonism leads to central nervous system and respiratory depression	▪ Fentanyl ▪ Carfentanil ▪ Diacetylmorphine ▪ Heroin ▪ Oxycodone (Oxycontin) ▪ Hydrocodone (Vicodin)	▪ Naloxone ▪ Artificial ventilation
Stress-Response/ Sympathomimetic/ Stimulant Toxidrome	▪ Increased pulse, respiration, and blood pressure ▪ Confusion and panic ▪ Increased pupil size ▪ Hyperventilation ▪ Sweating	Central nervous system excitation	▪ Caffeine ▪ Nicotine ▪ Amphetamines ▪ Mephedrone	▪ Benzodiazepines ▪ Activated charcoal

Further details about the medical management of chemical exposures are available from:

- CHEMM Toxidrome Overview and CHEMM Toxidrome Cards
- Report on the Toxic Chemical Syndrome Definitions and Nomenclature Workshop
- Chemical Attack: Warfare Agents, Industrial Chemicals, and Toxins (Fact Sheet)
- CDC's Chemical Emergency Preparedness and Response
- Emergency Response Safety and Health Database (ERSH-DB)
- ATSDR – Emergency Responders Home Page
- Multi-Service Tactics, Techniques, and Procedures for Treatment of Chemical Warfare Agent Casualties and Conventional Military Chemical Injuries
- The National Response Team's (NRT) Chemical Quick Reference Guides

Additional resources are listed in the Chemical Substance and Hazard Information Resources Appendix.

Appendix C. Chemical Incident Policy, Legislation, and Regulations

Response and recovery actions, roles, and responsibilities are described in numerous policy, legislative, and regulatory documents. These documents vary in their authority and scope, and in the types of incidents to which they apply. Understanding which policies and regulations apply to a particular situation is important step in ensuring effective planning and achieving response and recovery outcomes. Below are brief descriptions of documents that pertain specifically to chemical incidents. Note that this appendix should not be considered a comprehensive review of all relevant documents.

Legislation

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

First signed into law 1947, most recently amended 2003
FIFRA governs the registration, distribution, sale, and use of pesticides. With some exceptions, this includes any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant, or desiccant, or any nitrogen stabilizer. Registration requirements include pre-market review of health and environmental effects.

Clean Water Act and Oil Pollution Act (CWA/OPA)

First signed into law 1948, most recently amended 1990
The CWA was enacted in 1948, restructured and expanded in 1972, and amended by the OPA in 1990. The CWA, as amended by the OPA, authorizes response to discharges or threatened discharges of oil and CWA hazardous substances. The CWA applies to a discharge or substantial threat of discharge

- Into or on navigable waters
- On the adjoining shorelines to the navigable waters
- Into or on the waters of the exclusive economic zone
- That may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States.

The CWA and OPA also mandate that facilities with the potential to cause substantial harm to the environment by the discharging of oil into or on navigable water, are required to develop Facility Response Plans (FRPs). FRPs must identify a qualified individual with full response authority, identify available removal resources, describe relevant training/exercises, etc. Under CWA/OPA, EPA and USCG Area Committees are charged with developing Area Contingency Plans (ACPs) for oil spill responses within defined geographic areas. ACPs include information relevant to the economic and environmental importance of the area, federal and local agency response responsibilities, lists of available response resources, etc. A discussion of CWA/OPA as it relates to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund) is provided below.

Refer To

Area Contingency Planning and Facility Response Planning (ACP/FRP)

Clean Air Act (CAA)

First signed into law 1970, most recently amended 1990
The CAA regulates all emissions of pollutants into the atmosphere to control air pollution. The CAA requires that the EPA set national emissions standards for large or ubiquitous sources of air pollution, such as motor vehicles, power plants, and other industrial sources, and authorizes the EPA to establish National Ambient Air Quality Standards (NAAQS) which limit hazardous air pollutant (HAP) emissions to protect public health and welfare.

Refer To

Review the National Ambient Air Quality Standards (NAAQS)

Occupational Safety and Health Act (OSHA)

First signed into law 1970, most recently amended 2004
This act established the Occupational Safety and Health Administration (of the same acronym). The act includes provisions for Hazard Communications Standards (HCS) and Hazardous Waste Operations and Emergency Response Worker Protection (HAZWOPER) Standards. HCS ensures workers have access to information about their occupational hazards and identities of the chemicals they are exposed to while working, and the measures they can take to protect themselves. HCS requirements include labels on containers, safety data sheets, and training programs. HAZWOPER standards establish health and safety requirements for employers engaged in hazardous waste or emergency response operations. Specifically, these standards address required training, mandatory medical surveillance, and maximum exposure limits for workers engaged at hazardous waste site, treatment facilities, and emergency response locations.

In response to a Clean Air Act (CAA) congressional mandate, OSHA developed management requirements for highly hazardous substances, known as the Process Safety Management (PSM) of Highly Hazardous Chemicals standard (29 CFR 1910.119), issued in 1992. The PSM standard requires employers implement safety programs that identify, evaluate, and control hazards associated with explosives, flammable gases and liquids, and 137 listed highly hazardous chemicals.

The PSM standard outlines required features, or process safety elements, for employer safety programs, including employee participation, process hazard analysis (PHA), operating procedures, training, pre-startup safety review (PSSR), hot work permits, management of change (MOC), and more.

Refer To

- *Hazard Communications Standards (HCS)*
- Hazardous Waste Operations and Emergency Response Worker Protection (HAZWOPER) Standards
- *Process Safety Management (PSM) of Highly Hazardous Chemicals Standard* (CFR 1910.119)

Marine Protection, Research, and Sanctuaries Act (MPRSA)

First signed into law 1972, most recently amended 1992
The MPRSA, also known as the Ocean Dumping Act, prohibits the dumping of materials into the ocean that unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities.

Safe Drinking Water Act (SDWA)

First signed into law 1974, most recently amended 1996
The SDWA establishes national drinking water standards, such as maximum contaminant levels and treatment techniques. The SDWA also regulates underground injection control (UIC) wells, banning some types of underground disposal of RCRA hazardous wastes.

Resource Conservation and Recovery Act (RCRA)

First signed into law 1976, most recently amended 1996
The RCRA enables the EPA to regulate solid and hazardous waste[10] throughout its entire life cycle, from generation to disposal, including transportation, treatment, and storage. More generally, the RCRA establishes the framework for a national system of solid waste control, with subsections focusing on hazardous and non-hazardous waste.

The RCRA regulates a large and diverse group of facilities and entities, including hazardous waste generators, government agencies, small businesses, landfills, and gas stations. States play a lead role in implementing the EPA's RCRA regulations; however, if a state does not maintain a hazardous waste program, the EPA directly implements requirements in that state. The relationship of RCRA with CERCLA is discussed below.

[10] In this context, solid waste includes solids, liquids, and gases.

Toxic Substances Control Act (TSCA)

First signed into law 1976, most recently amended 2016
Similarly, to FIFRA, TSCA authorizes the EPA to regulate the production, importation, use, and disposal of specific chemical substances. When passed in 1976, the TSCA applied to any chemicals that posed an “unreasonable risk to health or the environment”. However, from enactment onward, TSCA regulations have applied to nearly[11] all new chemicals, regardless of whether they are toxic or pose particular risks. The EPA is required to maintain an inventory of all substances regulated by the TSCA, which contains more than 83,000 chemicals and counting. EPA provisions under the TSCA include prohibiting the manufacture or certain uses of particular chemicals; requiring labeling, testing, and record-keeping; limiting production volumes or concentrations; and controlling disposal methods.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

First signed into law 1980, most recently amended 1986
CERCLA, commonly known as Superfund, authorizes federal response to releases, or threatened releases, of hazardous substances that may endanger public health or the environment. Specifically, CERCLA authorizes short-term hazardous substance removals and long-term remedial responses. Additionally, CERCLA broadened the scope of the National Contingency Plan (see below), to include guidelines and procedures for responding to hazardous substance, pollutant, or contaminant releases. CERCLA hazardous substances include RCRA-regulated hazardous waste, and toxic pollutants regulated by the CAA, CWA, and TSCA (all discussed above).

Both the RCRA and CERLCA authorize short-term measures to address the immediate effects of a release, as well as investigations to determine long-term cleanup options. Under the RCRA, the facility owner or operator must implement corrective actions. Under CERCLA, a variety of parties may implement or lead remediation, including RPs, state governments, and the federal government. Cleanup funding also differs between the two acts— CERCLA mobilizes Superfund financing for removal and remediation actions at National Priorities List (NPL) sites, with liability provisions to ensure polluters pay whenever possible. Under the RCRA corrective action program, the owner or operator of the site is responsible for the cost of the cleanup in all instances.

Refer To

National Priorities List Sites

[11] The TSCA specifically exempts (1) mixtures; (2) FIFRA-regulated pesticides; (3) tobacco and tobacco products; (4) certain materials regulated by the Atomic Energy Act; and (5) foods, food additives, drugs, cosmetics, and devices regulated by the Federal Food, Drug, and Cosmetic Act (FFDCA).

CERCLA and CWA/OPA

Jointly, the CERCLA and CWA/OPA require that oil discharges and releases of reportable quantities of listed hazardous substances be reported to the National Response Center (NRC). The NRC forwards these notifications to pre-designated EPA and USCG OSCs. Generally, the EPA provides the OSC for incidents in the inland zone, and USCG provides the OSC for incidents in the coastal zone. NRC reporting processes are discussed in the Federal Preparedness, Response, and Recovery section of this document.

Superfund Amendments and Reauthorization Act (SARA)

First signed into law 1986
In 1986, CERCLA was amended by SARA. Among other things, SARA provided new enforcement authorities and settlement tools; increased state involvement in the Superfund program; and increased the size of the Superfund trust fund.

Emergency Planning and Community Right-to-Know Act (EPCRA)

First signed into law 1986
The SARA amendment to CERCLA included the EPCRA (SARA Title III). The EPCRA is intended to help communities prepare for chemical emergencies and increase public knowledge of the presence and threat of hazardous chemicals in their communities. It requires industry to report on storage, use, and releases of hazardous substances to federal, state, and local governments. In turn, the EPCRA requires SLTT governments to use this information to prepare for and protect their communities from relevant risks. Specifically, each state is required to appoint a State Emergency Response Commission (SERC) and Local Emergency Planning Committees (LEPC) for each emergency planning district. LEPCs must develop chemical emergency response plans for their districts and make information about chemicals within the community available to residents. SERCs subsequently review LEPC plans and activities.

Stafford Act

First signed into law 1988
The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act, 42 U.S. Code 5121- 5207) enables the President to declare disasters, subsequently authorizing FEMA to mobilize financial and physical relief resources to support state and local emergency response. The President may invoke the Stafford Act when requested by state governors and/or when a federal agency requests federal-to-federal assistance.

Under the Stafford Act, a presidential disaster declaration authorizes:

- Appointment of a Federal Coordinating Officer (FCO) to coordinate federal assistance to a state
- Federal agencies to receive reimbursement from FEMA for provided disaster assistance
- Disaster funds to be distributed to restore public infrastructure

- Disaster assistance such as temporary housing and case management to be distributed to suffering individuals

FEMA is the lead agency when the Stafford Act has been activated and designates the FCO. Federal response under a Stafford Act declaration is described in the Response & Recovery FIOP.

Doctrine and Regulations

National Oil and Hazardous Substances Pollution Contingency Plan (NCP)

Published in 1968, most recently amended 1996

Often referred to simply as the National Contingency Plan, the NCP outlines federal response for oil spills and hazardous substance releases. It is intended to promote coordination among the hierarchy of responders and contingency plans. Among other things, the NCP established the National Response Team, Regional Response Teams, and the general responsibilities of federal OSCs. For more information about the NCP, see the Federal Preparedness, Response, and Recovery section of this document.

National Response Framework (NRF)

Updated in October 2019

The fourth edition of the NRF supports requirements identified in Presidential Policy Directive-8: National Preparedness (PPD-8); the NRF is the foundational emergency management doctrine for all types of incidents. The framework includes a series of Emergency Support Functions (ESFs), Support annexes, and Incident annexes that provide detailed incident response information.

Guidance for chemical incident response can be found in the ESF 10: Oil and Hazardous Materials Response Annex, ESF 15: External Affairs, Support Annexes, and the Response & Recovery Federal Interagency Operational Plan (FIOP), and their Oil and Chemical Incident Annex (OCIA) (see below). Collectively, these documents provide guidance to support an effective Federal response.

Response & Recovery Federal Interagency Operational Plan (FIOP)

Published 2021

The FIOP is an all-hazards plan that describes how the federal Government coordinates its efforts to save lives, protect property and the environment, and meet basic human needs during response to an emergency or disaster. Further, it describes the concept of operations for integrating existing national-level federal capabilities to support SLLT, insular area, and federal plans for achieving recovery outcomes. The FIOP guides federal agencies to achieve unity of effort when implementing coordinated response and recovery actions.

Oil and Chemical Incident Annex (OCIA)

Published 2021

The OCIA is an annex to the Response & Recovery FIOP described above. It describes the hierarchy and roles of federal interagency partners responding to oil/chemical incidents for various degrees of severity. Specifically, it details chemical incident OSC assessments, NCP processes, Stafford Act processes, ESF support, and more.

Food and Agricultural Incident Annex (FAIA)

Published 2019

The FAIA is an Annex to the Response & Recovery FIOP described above. It describes the hierarchy and roles of federal interagency partners responding to food or agricultural incidents that exceed lead federal agency response capabilities. With regard to chemical releases, the FAIA may apply to incidents that result in:

- Large-scale animal injury or death
- Intentional or incidental adulteration of the food supply chain
- Upstream and downstream disruption of consumer markets and the environment

Appendix D. Chemical Planning and Notification Requirements for Responsible Parties

This appendix describes legislated planning and notification requirements for owners and operators of facilities that store, produce, distribute, and/or use hazardous chemicals (referred to as "Responsible Parties", RPs[12]). Specifically, it outlines the directed RP planning, reporting, and notification processes mandated by the following Acts:

Table 12: Chemical Planning and Notification Requirements for Responsible Parties

Act	Description
CERCLA	Requires RPs to report releases of hazardous substances that exceed specified volume thresholds to the National Response Center.
EPCRA	Requires RPs to report hazardous substance inventories and related risks to state and localstakeholders; these are publicly disclosed to aid community preparedness and response. EPCRA also requires RPs to notify state and local officials immediately after recognizing a potential release from their facilities.
Section 112(r) of the CAA Amendments of 1990	Establishes the EPA Risk Management Program (RMP) that requires facilities that hold hazardous substances equal to or exceeding specified volume thresholds to develop and implement a risk management strategy for accident prevention and mitigation.

These authorities serve as key legal foundations for enhancing state, local, tribal, and territorial (SLTT) and public preparedness for and response to chemical incidents by requiring RPs to disclose potential chemical risks to jurisdictions and the public. To aid chemical incident preparedness and response, planners can access RP data required under these authorities via a variety of EPA-maintained databases that are open to the public, namely the many Envirofacts search tools described below. Most notably, under these authorities, RPs share both responsibility and liability for preventing, mitigating, and responding to chemical incidents that result from their activities.

[12] CERCLA, Section 107(a) established four categories of Responsible Parties which include: (1) any person who currently owns or operates a facility or vessel from which a hazardous substance was released, (2) any person who at the time of disposal of a hazardous substance owned or operated the facility at which such disposal occurred, (3) any person who arranged for the disposal or treatment of a hazardous substance (often referred to as a generator of waste) as well as any person who arranged for the transport of a hazardous substance for disposal or treatment, and (4) any person who accepts or accepted a hazardous substance for transport to a disposal or treatment facility, incineration vessel, or site selected by such person.

Planning Requirements

Section 112(r) of the CAA Amendments and Section 303 of the EPCRA require Responsible Parties to establish risk-based strategies to prevent, mitigate, and respond to releases of hazardous substances from their facilities.

Under the General Duty Clause (GDC), Section 112(r)(1) of the CAA Amendments of 1990, stationary sources that manage extremely hazardous substances (EHSs) in volumes at or above threshold planning quantities (TPQs) are responsible for developing strategies to prevent and mitigate the consequences of chemical releases.[13] Pursuant to Section 112(r)(7), such strategies are to be documented within the Risk Management Plans that are to be submitted to EPA, the Chemical Safety Board (CSB), and state and local officials every five years. In accordance with Section 112(r)(7)(B), RMPs must include (1) a risk assessment and worst-case consequence analysis of potential accidental releases of hazardous chemicals; (2) a prevention plan, including chemical safety measures and employee training, based on the findings of the risk assessment and consequence analysis; and (3) a response plan that includes mitigating releases as well as notifying SLTT authorities. Planners and the public can access the RMPs of approximately 12,500 Section 112-regulated facilities via Federal Reading Rooms.[14]

EPCRA Section 303 requires RPs to assist Local Emergency Planning Committees (LEPCs) or Tribal Emergency Planning Committees (TEPCs) in developing response, evacuation, and training plans. EPCRA, which established LEPCs and TEPCs along with Tribal Emergency Response Commissions (TERCs) and State Emergency Response Commissions (SERCs) as vehicles to tailor chemical incident planning in accordance with jurisdictional risks,[15] authorizes LEPCs/TEPCs to require facilities to provide additional information necessary to aid local emergency planning. According to EPA guidance, SLTT planners should use this information to develop (1) response, notification, and evacuation procedures, (2) processes for determining environmental and population risks, and (3) training and exercise schedules. Additionally, under Section 303(d), the facility must provide a representative to serve on the LEPC/TEPC.

Reporting Requirements

Pursuant to Sections 302, 311, and 312 of EPCRA, RPs that manage EHSs and/or hazardous chemicals (as defined by EPA[16]) in volumes at or above TPQs[17] must provide inventory documentation and additional information to SLTT officials. Section 302 directs facilities that meet these requirements to report their EHS inventories and provide additional information to the LEPC/TEPC and SERC/TERC. Such information may include the identification of key chemicals of concern, their risks, and prevention and mitigation measures implemented at the facility. Under

[13] EHSs are listed in 40 CFR part 355, Appendices A and B.
[14] Federal Reading Rooms for Risk Management Plans (RMP) https://www.epa.gov/rmp/federal-reading-rooms-risk-management-plans-rmp.
[15] See EPCRA Sections 301-303.
[16] EPA Consolidated List of Lists https://www.epa.gov/epcra/consolidated-list-lists
[17] 40 CFR part 355, Appendices A and B.

Section 302(a), EPA is authorized to revise the EHS and TPQ list, which is presented in 40 CFR part 355, Appendices A and B.

EPCRA Sections 311 and 312 require RPs that manage either EHSs or hazardous chemicals[18] in volumes at or above their corresponding TPQs to submit either a Safety Data Sheet (SDS, also referred to as a Material Safety Data Sheets, MSDS) or a hazardous chemicals list (Section 311) as well as inventory information (Section 312) to the LEPC/TEPC, SERC/TERC, and local fire department. SDSs contain information on the properties of each chemical, human health and environmental risks, and handling, storage, and transportation precautions.[19] If the RP chooses to provide a hazardous chemicals list, the RP must identify the chemical name of each substance being reported and indicate whether it is defined in accordance with OSHA standards[20] as either a physical hazard (e.g., flammable gas under pressure) or health hazard (e.g., carcinogen).

EPCRA Section 312 requires facilities regulated by Section 311 to submit either Tier I or Tier II Emergency and Hazardous Chemical Inventory Forms to LEPCs/TEPCs, SERCs/TERCs, and the local fire departments. In general, the Tier I TPQ is set at 10,000 pounds. Tier I forms provide the minimum information which includes: (1) a range estimate of maximum volumes likely present at the facility at any time during the preceding year, (2) an estimated average daily inventory volume, and (3) general location within the facility.[21] Tier II forms, on the other hand, must be submitted only upon LEPC/TEPC or SERC/TERC request. The information required in Tier II inventory forms is dependent on state requirements[22] and generally provides Tier 1 information in addition to: (1) a description of facility storage and (2) an indication of whether the RP has chosen to disclose the location information to the public.[23] The public can access Tier I and Tier II forms via contacting either the LEPC/TEPC or SERC/TERC with jurisdiction.[24]

Approximately 90,000 and 400,000 facilities are regulated by EPCRA Section 302 and Sections 311 and 312, respectively. In accordance with the EPCRA "right-to-know" principle, all information is made available for planners and the public, although, under Section 324, exceptions apply regarding sensitive and trade secret information. Section 327 provides an exemption for reporting substances in transportation.

The Toxic Release Inventory (TRI) established in Section 313 of EPCRA serves as a central database for state and local officials and the public. The TRI identifies (1) industrial facilities[25] that release

[18] "Hazardous chemicals" are defined in 29 CFR, Section 1910.1200(c).
[19] 40 CFR §370.20. For more on information contained within MSDS, visit: https://www.osha.gov/Publications/OSHA3514.html.
[20] Guidance for Hazard Determination https://www.osha.gov/dsg/hazcom/ghd053107.html#:~:text=The%20HCS%20definitions%20for%20physical,reactive)%20or%20water%2Dreactive.
[21] 40 CFR §370.
[22] State Tier II Reporting Requirements and Procedures https://www.epa.gov/epcra/state-tier-ii-reporting-requirements-and-procedures.
[23] 40 CFR §370.42.
[24] How will citizens have access to Tier I or Tier II inventory forms? https://www.epa.gov/epcra/how-will-citizens-have-access-tier-i-or-tier-ii-inventory-forms.
[25] For information on which industries are covered by TRI, visit https://www.epa.gov/toxics-release-inventory-tri-program/tri-covered-industry-sectors#Anchor%201.

toxic chemicals into the environment or transport them off-site, (2) which chemicals are released or transported (by volume), (3) pollution prevention (P2) activities implemented within each facility to reduce chemical releases into the environment, and (4) health risks associated with each chemical release. In general, "toxic chemicals" are defined by the health and environmental hazards they pose, which EPA classifies as (1) cancer or other chronic human health effects, (2) significant adverse acute human health effects, or (3) significant adverse environmental effects. As of 2020, toxic chemicals included 767 individually listed chemicals and 33 chemical categories.[26] To alert planners and the public about priority hazards in their jurisdiction, EPA assigns a numerical risk score to facilities that manage toxic chemicals using the comparative Risk-Screening Environmental Indicators (RSEI) model.[27] Previous years' scores are also maintained for planners and the public to assess historical trends and remaining issues within their jurisdiction.

For access to additional chemical incident preparedness and response information not included in the TRI, planners and the public can use the following search tools housed within the Envirofacts website[28]:

RCRAInfo[29]

This database provides information on the activities and locations of hazardous waste generators, transporters, and treatment, storage, and disposal facilities (TSDFs) in accordance with Subtitle C, Hazardous Waste Management Requirements[30] of the Resource Conservation and Recovery Act (RCRA). Information provided includes (1) general handler information, (2) permit or closure status, (3) compliance with federal and state regulations, and (4) compliance with EPA- required corrective action orders.[31] By inquiring online at RCRAInfo, planners can access EPA's Biennial Hazardous Waste Report, which specifies facility generation and final disposition of hazardous waste ("cradle to grave").

National Emissions Inventory (NEI)[32]

Released every three years, the NEI uses Emissions Inventory System (EIS) data provided by SLTT environmental agencies to issue pollutant air emissions estimates of specified pollutants and their precursors. Point sources[33], or stationary sources that directly channel pollutants into the

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[26] TRI-Listed Chemicals https://www.epa.gov/toxics-release-inventory-tri-program/tri-listed-chemicals.
[27] Risk-Screening Environmental Indicators (RSEI) Model https://www.epa.gov/rsei#:~:text=RSEI%20incorporates%20information%20from%20the,toxicity%2C%20and%20potential%20human%20exposure.
[28] Envirofacts. https://enviro.epa.gov/.
[29] RCRAInfo Overview. https://www.epa.gov/enviro/rcrainfo-overview.
[30] Subtitle C of the RCRA authorizes EPA to establish: (1) hazardous waste standards for generators and transporters; (2) minimum standards for owners and operators of hazardous waste treatment, storage, and disposal facilities (TSDFs); (3) TSDF permit programs; and (4) criteria for states to regulate their own hazardous waste programs.
[31] See the "RCRAInfo Help and Guidance" document at: https://rcrainfo.epa.gov/rcrainfo-help/application/RCRAInfoHelpAndGuidance.pdf.
[32] Air Emissions Inventories. https://www.epa.gov/air-emissions-inventories
[33] A "point source," as defined in Section 502(14) of the Clean Water Act, refers to a "discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged."

environment, listed within the NEI include industrial facilities, electric power plants, airports, and asphalt/rock crushing facilities, and other smaller industrial, non-industrial, and commercial facilities. Non-point sources, whose operations result in the indirect entry of pollutants into the environment, include residential heating and commercial combustion appliances, asphalt paving operations, and the use of commercial and consumer solvents. Certain states also designate non-point sources such as dry cleaners, gas stations, and livestock facilities, which are then included in the NEI as non-point sources. Additionally, the NEI provides air emission estimates for on-road sources (e.g., cars and trucks), off-road sources (e.g., construction equipment, commercial marine vessels), and event sources (e.g., wildfires, prescribed burns).

Permit Compliance System (PCI) and Integrated Compliance Information System (ICIS)[34]

The PCS-ICIS databases provide information on companies that hold National Pollutant Discharge Elimination System (NPDES) permits, which allow for the lawful discharge of wastewater into US waters. The NPDES program, established by the Clean Water Act, authorizes discharges within pre-determined limits (tailored to each facility) and establishes active monitoring and reporting requirements to ensure permit-holder compliance with both state and federal standards. Planners can use the database to identify NPDES facilities within their jurisdiction by name, location, permit number, industrial sector, and chemicals inventoried.[35]

Notification Requirements

EPCRA and CERCLA require RPs to immediately report all releases of hazardous substances that meet or exceed reportable quantities (RQs) to local, state, and federal stakeholders. Under Section 304 of EPCRA, RPs should notify the LEPC/TEPC and SERC/TERC. Section 103(a) of CERCLA requires notification of such releases to the US Coast Guard (USCG)-led National Response Center (NRC) in addition to state and local stakeholders. An EPA-based (for inland incidents) or USCG- based (for coastal incidents) On-Scene Coordinator (OSC) then leads the federal response to a discharge of oil or release of a hazardous substance, as described in the Federal Preparedness, Response, and Recovery section of this document.

[34] PCS-ICIS Search. https://www.epa.gov/enviro/pcs-icis-search.
[35] As of 2020, data were not yet provided by facilities located in Wyoming.

Appendix E. Federal Funding for Incident Response

The costs associated with responding to chemical incidents vary depending on the size and scope of the incident and can be substantial. For example, it cost Exxon over $2 billion to clean up the Valdez oil spill, not including the criminal fines, punitive damages, natural resource damages, or other costs – estimated at approximately another $2 billion – associated with the spill.[36] Few RPs would be able to fund cleanup activities at that magnitude; luckily most chemical releases are much smaller in scale. Still, federal financial support may be needed during response (and recovery).

Access to funding sources for chemical incident response activities varies depending on incident specifics, most notably, the extent of federal involvement in the response. If the President has not declared an emergency/major disaster under the Stafford Act, then funding is subject to the processes detailed in the National Response Framework Financial Management Support Annex; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); Clean Water Act (CWA); and Oil Pollution Act (OPA). However, if there is a presidential declaration under the Stafford Act, funding is subject to the processes and sources described in the Stafford Act.

Refer To

- *National Response Framework* (NRF) *Financial Management Support Annex*
- CERCLA, CWA, and OPA descriptions in Appendix C

[36] EXXON SHIPPING CO. ET AL. v. BAKER ET AL., 200 U.S. 321,337 (2008) (Souter concurring opinion). Accessed 9/23/2020 at https://www.supremecourt.gov/opinions/07pdf/07-219.pdf

Table 13: Federal Funding for Incident Response

	Fund Source	Administered By	Coverage	Cap Amounts
Non-Stafford Act	Agency-appropriated Funds	Applicable Department/ Agency	All discharges or releases	As established by Congress
Non-Stafford Act	Responsible Party (RP)	RP	All discharges or releases as defined in CERCLA and CWA/OPA	As specified in CERCLA and CWA/OPA
Non-Stafford Act	Oil Spill Liability Trust Fund	USCG	Oil discharges only	$1 billion per incident of which no more than $500 million may be expended for natural resource damage assessments and claims
Non-Stafford Act	CERCLA (Superfund) Trust Fund	EPA	Chemical releases	$2M in total costs or 12 months in duration for federally funded "removal" response, unless certain statutory criteria are met
Stafford Act	Disaster Relief Fund	FEMA	Task initiated pursuant to ESF 10 or other ESF mission assignments	$5 million for *emergency* declarations. No limit for *major disaster* declarations.

Agency-Appropriated Funds

Some federal departments and agencies do not have designated funds to cover emergency and disaster operations. Nevertheless, they are expected to respond if the required operations fall within their statutory responsibilities. These agencies and departments must use agency-appropriated funds from their existing funding streams. If available funds are insufficient, agencies and departments may implement the Economy Act, which enables federal agencies to request goods and services from other federal agencies and to pay the costs of those goods and services.

Refer To

Economy Act

Responsible Parties (RPs)

Under CERCLA and the CWA, RPs are liable for the costs of responding to releases or substantial threats of release from their facilities/assets. RPs may voluntarily, or under an order, directive, or agreement, conduct response actions using their own funding.

NCP-Related Funding Sources

To fund federal cleanup activities when RPs cannot fully cover the cost, Congress established two funds—the Oil Spill Liability Trust Fund (OSLTF) and the CERCLA (Superfund) Trust Fund.

The OSLTF is administered by the USCG National Pollution Funds Center (NPFC) for oil discharges, as defined by the CWA. Superfund is administered by the EPA for releases of hazardous substances, pollutants, and contaminants as defined by CERCLA (generally excluding oil).

Under both funds, other federal agencies can conduct reimbursable response support activities when directed/requested by the OSC by entering into an interagency agreement with the EPA or USCG. For the OSLTF such agreements are called Pollution Removal Funding Authorizations (PRFAs).

Local Government Reimbursements (LGR)

The EPA may reimburse local governments for release related expenses. This program provides up to $25,000 per incident. Local governments must apply for reimbursement.

Refer To

- Oil Spill Liability Trust Fund (OSLTF)
- *CERCLA* (Superfund) Trust Fund
- Local government reimbursement program (LGR)

Stafford Act Funding

The Stafford Act authorizes the federal government to deliver financial, technical, and logistical assistance to states and localities during major disasters or emergencies; the President is responsible for making the declaration that mobilizes Stafford Act funds. Both a major disaster declaration and an emergency declaration under the Stafford Act authorize supplemental federal funding. The President may declare an emergency for any occasion they believe requires federal assistance; emergency assistance is limited to $5 million. For natural catastrophes, the President may declare a major disaster. Natural catastrophes include hurricanes, tornadoes, earthquakes, volcanic eruptions, droughts, etc.[37] as well as fires, floods, and explosions, regardless of cause. There is no assistance limit for major disasters.

FEMA is responsible for coordinating federal support under the Stafford Act, including financial support. This includes distribution of disaster funds to restore public infrastructure and reimbursement for recovery and response workers. Additionally, FEMA is responsible for reimbursing other federal agencies for their activities during response and recovery.

Refer To

Stafford Act Support to States Overview

FEMA Grants

FEMA provides grant funding for pre- and post-emergency or -disaster related projects, such as critical recovery initiatives and innovative research. FEMA's grants fall into three broad categories: hazard mitigation, preparedness, and resilience grants. Hazard mitigation grants fund risk reduction or removal activities before an incident or disaster occurs, such as annual funds for planning programs, flood damage reduction, facility retrofitting, and forest/grassland fire management. Preparedness grants fund non-disaster support for citizens and first responders, such as cybersecurity projects, public transportation systems, firefighters, law enforcement, and trainings. Two types of resilience grants are funded: dam safety grants and earthquake risk grants. Additional details on each type of grant can be found in eligibility requirement materials.

Refer To

FEMA Grants

[37] For the complete list of eligible natural catastrophes, see section 102 of the Stafford Act (42 U.S.C 5122)

Appendix F. Emergency Support Functions (ESFs)

Table 14: Emergency Support Functions (Last Updated: July 31, 2020)

Emergency Support Function	Purpose
ESF #1 – Transportation Annex	Provides support by assisting local, state, tribal, territorial, insular area, and federal governmental entities, voluntary organizations, non-governmental organizations (NGOs), and the private sector in the management of transportation systems and infrastructure during domestic threats or in response to actual or potential incidents.
ESF #2 – Communications Annex	Supports the restoration of communications infrastructure, coordinates communications support to response efforts, facilitates the delivery of information to emergency management decision makers, and assists in the stabilization and reestablishment of systems and applications during incidents.
ESF #3 – Public Works and Engineering Annex	Coordinates and organizes the resources of the Federal Government to facilitate the delivery of multiple core capabilities.
ESF #4 – Firefighting Annex	Provides federal support for the detection and suppression of wildland, rural, and urban fires resulting from, or occurring coincidentally with, an all-hazards incident requiring a coordinated national response for assistance.
ESF #5 — Information and Planning Annex	Collects, analyzes, processes, and disseminates information about a potential or actual incident, and conducts deliberate and crisis action planning activities to facilitate the overall activities in providing assistance to the whole community.
ESF #6 – Mass Care, Emergency Assistance, Housing, and Human Services Annex	Coordinates and provides life-sustaining resources, essential services, and statutory programs when the needs of disaster survivors exceed local, state, tribal, territorial, and insular area government capabilities.
ESF #7 – Logistics Annex	Integrates whole community logistics incident planning and support for timely and efficient delivery of supplies, equipment, services, and facilities. Facilitates comprehensive logistics planning, technical assistance, training, education, exercise, incident response, and sustainment that leverage the capability and resources of federal logistics partners, public and private stakeholders, and non-governmental organizations (NGOs) in support of both responders and disaster survivors.

Emergency Support Function	Purpose
ESF #8 – Public Health and Medical Services Annex	Provides the mechanism for federal assistance to supplement local, state, tribal, territorial, and insular area resources in response to a disaster, emergency, or incident that may lead to a public health, medical, behavioral, or human service emergency, including those that have international implications.
ESF #9 – Search and Rescue (SAR) Annex	Deploys federal SAR resources to provide lifesaving assistance to local, state, tribal, territorial, and insular area authorities, including local SAR Coordinators and Mission Coordinators, when there is an actual or anticipated request for federal SAR assistance.
ESF #10 – Oil and Hazardous Materials Response Annex	Provides federal support in response to an actual or potential discharge and/or release of oil or hazardous materials.
ESF #11 – Agriculture and Natural Resources Annex	Organizes and coordinates federal support for the protection of the nation's agricultural and natural and cultural resources during national emergencies. Works during actual and potential incidents to provide nutrition assistance; respond to animal and agricultural health issues; provide technical expertise, coordination and support of animal and agricultural emergency management; ensure the safety and defense of the nation's supply of meat, poultry, and processed egg products; and ensure the protection of natural and cultural resources and historic properties.
ESF #12 - Energy Annex	Provides support to the Department of Homeland Security (DHS) by assisting local, state, tribal, territorial, and federal government entities, non-governmental organizations (NGOs), and the private sector by coordinating government capabilities, services, technical assistance, and engineering expertise during disasters and incidents that require a coordinated federal response. The term "energy" includes producing, storing, refining, transporting, generating, transmitting, conserving, building, distributing, maintaining, and controlling energy systems and system components.
ESF #13 – Public Safety and Security Annex	Provides federal public safety and security assistance to local, state, tribal, territorial, and federal organizations overwhelmed by the results of an actual or anticipated natural/manmade disaster or an act of terrorism.
ESF #14 – Cross-Sector Business and Infrastructure	Supports the coordination of cross-sector operations, including stabilization of key supply chains and community lifelines, among infrastructure owners and operators, businesses, and their government partners.

Emergency Support Function	Purpose
ESF #15 – External	Provides accurate, coordinated, timely, and accessible information to affected audiences, including governments, media, the private sector, and the local populace, including vulnerable populations such as children, those with disabilities, individuals with limited English proficiency, etc.

Appendix G. CBRN Emergency Response Assets and Teams

Table 15: General CBRN Incident Response Assets and Teams

Asset	Description	Agency/Owner
Chemical Biological Incident Response Force (CBIRF)	Provides command and control capabilities, chemical detection and identification, search and rescue, decontamination, and emergency medical care for contaminated personnel.	Marine Corps
Consequence Management Advisory Division (CMAD)	Provides science-based solutions and response services during all phases of crisis and consequence management via deployed personnel and assets.	EPA
Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive (CBRNE) Enhanced Response Force Package (CERFP)	Provides incident response capabilities to the requesting governor, such as search of collapsed buildings and structures, rescue to extract trapped casualties, mass decontamination, medical triage, and initial treatment to stabilize patients for transport to medical facilities.	National Guard
Chemical Operations Support Specialist (COSS)	FEMA CBRN Office capability currently under development that will provide a cadre of chemical emergency prevention, response, and recovery subject-matter experts for assistance during chemical incidents.	FEMA
Command & Control CBRN Response Element (C2CRE)	The C2CRE is composed of two teams. The alpha team provides reconnaissance, decontamination, aviation, engineering, search/extraction, logistics, medical, transportation, fuel distribution, water purification, and legal services. The beta team provides medical, transportation, and fuel distribution services.	Army Reserve
Defense CBRN Response Force (DCRF)	Provides command and control CBRN assessment, search and rescue, decontamination, emergency medical care, medical and surgical capability, physical security, engineering, logistics, transportation, air/ground MEDEVAC, and aviation lift.	USNORTHCOM

Asset	Description	Agency/Owner
Domestic Emergency Support Team (DEST)	Rapidly deployable team of interagency CBRN experts that focuses on contingency planning, facilitates interagency crisis management, assesses crisis management based on nuclear weapons/devices, and prioritizes response assets and capabilities.	FEMA
Emergency Management Assistance Compact (EMAC)	Assists during governor-declared states of emergency or disaster by enabling states to send personnel, equipment, and commodities to assist with response and recovery efforts in other states. Through EMAC states can also transfer services, such as shipping newborn blood from a disaster-impacted lab to a lab in another state, and conduct virtual missions, such as geographic information system (GIS) mapping.	National Emergency Management Association (NEMA)
Emergency Response Division (ERD)	Provides scientific expertise to support incident response, specifically assisting OSCs.	NOAA
Environmental Response Team (ERT)	Provides technical and logistical assistance in responding to environmental emergencies, such as oil or hazardous materials spills. Also supports characterization and cleanup of hazardous waste sites.	EPA
Homeland Response Force (HRF)	Conducts command and control, casualty assistance, search and extraction, decontamination, medical triage and stabilization, and fatality search and recovery.	National Guard
Incident Management Assistance Team (IMAT)	Provides situational awareness and subject matter expertise to determine the level and type of immediate federal support required to assist decision-makers at all levels of government.	FEMA
Regional and National Incident Support Teams (RIST and NIST)	US Public Health Service (USPHS) Teams, NISTs and RISTs provides continual event need assessments, support and direction for incoming response assets, coordination of deployed field assets, on-site incident management, response asset health and safety, and demobilization support.	HHS
National Response Team (NRT)	Provides technical assistance, resources and coordination on preparedness, planning, response and recovery activities for emergencies involving hazardous substances, pollutants and contaminants, oil, and weapons of mass destruction in natural and technological disasters and other environmental incidents of national significance. The NRT also provides valuable *Quick Reference Guides* for various hazardous materials.	Interagency

Asset	Description	Agency/Owner
Planning and Response Team (PRT)	Provides ice, water, power, debris removal, temporary housing, temporary roofing, and structural safety assessments.	Army Corps of Engineers
Rapid Deployment Force (RDF)	Provides pre-hospital triage and treatment, mass care, point of distribution operation, medical surge, isolation and quarantine, community outreach and assessments, humanitarian assistance, on-site incident management, medical supplies management and distribution, public health needs assessment and epidemiological investigations, animal health and emergency support, etc.	HHS
Surge Capacity Force (SCF)	Assists in various program areas, such as acquisitions, disaster survivor assistance, external fairs, financial management, human resources, individual assistance, information technology, logistics, planning, public assistance, and the national processing service center.	DHS

Table 16: Criminal/Terror Investigation Assets and Teams

Asset	Description	Agency/Owner
Hazardous Evidence Response Team (HERT)	Supports response to incidents or threats involving weapons of mass destruction or the criminal use of CBRN materials. Provides training, leadership, and subject-matter expertise in hazardous evidence collection, crime scene management, and the processing of forensic evidence in CBRN crime scenes.	FBI
National Criminal Enforcement Response Team (NCERT)	Supports environmental crime investigations involving chemical, biological, or radiological releases to the environment. Collects forensic evidence in contaminated zones, serves as law enforcement liaisons, and provides protective escorts for EPA OSCs and other EPA personnel.	EPA
Weapons of Mass Destruction – Civil Support Team (WMD—CST)	Supports civil authorities at domestic CBRNE incident sites by identifying CBRNE agents/substances, assessing current or projected consequences, advising on response measures, and assisting with requests for follow-up from state and federal military forces.	National Guard

Table 17: Medical Assets and Teams

Asset	Description	Agency/Owner
Applied Public Health Team (APHT)	Provides resources and assistance to local health authorities. Primary activity and reporting areas include epidemiology/surveillance, preventive medical services delivery, and environmental public health issues.	HHS
Commissioned Corps of the United States Public Health Service (USPHS)	Assists with healthcare delivery, disease control and prevention, biomedical research, and food and drug regulation. Corps emergency response teams are trained and equipped to respond to public health crises and national emergencies such as natural disasters, disease outbreaks, or terrorist attacks.	HHS
Disaster Medical Assistance Team (DMAT)	A team of advanced clinicians (nurse practitioners/physician assistants), medical officers, registered nurses, respiratory therapists, paramedics, pharmacists, safety specialists, logistical specialists, information technologists, communication specialists, and administrators, available for emergency response.	HHS
Disaster Mortuary Operations Response Team (DMORT)	Provides technical assistance and consultation on fatality management and mortuary affairs, such as tracking and documenting remains and personal effects, establishing temporary morgue facilities, assisting in determination of cause of death, collecting ante-mortem data, performing forensic dental pathology, etc.	HHS
International Medical Surgical Response Team (IMSURT)	Responds to acts of terrorism to treat and stabilize injured survivors. Outfitted with mobile equipment, supplies, and pharmaceuticals.	HHS
Joint Patient Assessment and Tracking System (JPATS)	The ESF #8 federal patient tracking system. Tracks and records patients' current and prior locations, destinations, requirements for transport, transport types, reasons for location changes, and times of departure and arrival. States and local health departments are encouraged to consider using JPATS for their patient tracking application needs.	HHS
Medical Reserve Corps (MRC)	A corps of medical and public health professionals that prepares for and responds to natural disasters and other emergencies affecting public health. Supports mass dispensing, emergency sheltering, disaster medical response, health screenings, etc.	HHS

Asset	Description	Agency/Owner
Mental Health Team (MHT)	In response to emergency incidents, provides mental health assessment, diagnosis, and treatment, screens for suicide risks, acute and chronic risk reactions, substance abuse, and mental health disorders, supports development of behavioral and health training programs for impacted populations, provides specialized counseling, psychological first aid, and crisis intervention.	HHS
National Disaster Medical Systems (NDMS)	Supplements SLTT healthcare response and medical systems, including providing medical care and patient transportation services.	HHS
National Medical Response Team (NMRT)	Provides medical care following a nuclear, biological, and/or chemical incident. Capable of providing mass casualty decontamination, medical triage, and primary and secondary medical care to stabilize survivors for transportation to tertiary care facilities in a hazardous material environment.	HHS
National Veterinary Response Team (NVRT)	Provides expert veterinary care to service animals, including security animals, during disasters and certain national security events. Also assesses environmental and zoonotic diseases.	HHS
Readiness and Deployment Operation Group (RedDOG)	Response capabilities vary by tier, but include Rapid Deployment Force Teams (RDFs), Applied Public Health Teams (APHTs), Mental Health Teams (MHTs), Service Access Teams (SATs), National Incident Support Teams (NISTs), Regional Incident Support Teams (RISTs), and Capitol Area Provider Teams (CAPTs).	HHS
Service Access Team (SAT)	Assesses and monitors ongoing health and human services needs of affected populations, particularly serving at-risk individuals and populations.	HHS
Strategic National Stockpile (SNS)	Provides medicine and medical supplies when a public health emergency overwhelms local supplies. Contains unique supplies to respond to certain CBRN agents, such as medical countermeasures (MCMs).	HHS

Table 18: Infrastructure Assets and Teams

Asset	Description	Agency/Owner
249th Engineer Battalion	Generates power for military units and federal relief organizations during full-spectrum operations.	Army Corps of Engineers
Transportation Disaster Assistance (TDA)	Coordinates disaster response resources for federal, state, local, and volunteer agencies. TDA Specialists work closely with these agencies and transportation carriers to meet the needs of disaster survivors.	National Transportation Safety Board (NTSB)

Table 19: Search and Rescue Assets and Teams

Asset	Description	Agency/Owner
Office of Search and Rescue (CG-SAR)	Conducts maritime search and rescue operations.	USCG
Urban Search & Rescue (USAR) Task Forces	Supports state and local emergency responder efforts to locate victims and survivors and manage recovery operations.	FEMA

Table 20: Federal Coordination Assets and Teams

Asset	Description	Agency/Owner
Consequence Management Coordination Unit (CMCU)	Ensures information sharing and coordination between FBI-led Protection and Prevention operations and FEMA-coordinated consequence management Response operations.	Interagency

Appendix H. Environmental Containment and Remediation Options

Overview of Environmental Remediation and Containment Options[38]

The strategies available for containing and remediating released chemicals are highly chemical- and situation- dependent. Effective methods differ with substance, and different approaches are needed depending on the substance's physical and chemical properties, the release medium (air, soil, sediment, groundwater, or surface water), and release site-specific factors. Major approaches to chemical substance containment and environmental remediation include:

Destruction or Alteration of Contaminants

Thermal, biological, physical, and chemical treatment methods/destruction technologies can be applied to contaminated media at the release site (in situ) or following removal from the site (ex situ). Treatments may destroy or alter the substance; alterations include reduction of the substance's mobility or mass and "phytotechnology" strategies that use plants to degrade contaminants in soil and water. Note that when treatment and/or disposal procedures cannot be performed on-site, substance identification and characterization are key to determining how to safely and efficiently package and transport contaminated materials for removal from the site.

Extraction or Separation of Contaminants from Environmental Media

Treatment technologies (including phytoremediation) are commonly used to extract and separate contaminants from soil and groundwater. The removal of chemicals in air is possible although applications are limited.

Immobilization of Contaminants

Immobilization technologies include stabilization/solidification and containment technologies. Stabilization and solidification processes immobilize substances, reducing their ability to move through soil, groundwater, or surface water. Containment (via booms, neutralizers, sorbents, etc. as described in KPF 4, Control the Spread of Contamination) is often chosen to prevent the migration of contaminants through environmental media when treatment is impractical.

[38] See the Federal Remediation Technologies Roundtable (FRTR) Technology Screening Matrix and Reference Guide at https://frtr.gov/matrix/default.cfm, and the EPA's Contaminated Site Clean-Up Information at https://clu-in.org/ for more information on discussed topics.

Each approach carries risks and benefits in terms of cost and time needed for treatment. For example, in situ soil or sediment treatments do not require media excavation or transportation, thus affording potentially significant cost savings over ex situ treatments. However, longer treatment periods are generally required for in situ treatments, and the uniform progression of treatments can be difficult to verify. In contrast, ex situ soil/sediment treatments require excavation, leading to increased costs and requirements for engineering, equipment, permitting, and material handling/worker exposure considerations, but also generally require shorter treatment durations, and better uniformity in progression, promoted by the ability to homogenize, screen, and continuously mix the soil. For in situ groundwater and leachate treatments, cost savings come when the water can be treated without bringing it to the surface. However, as with in situ soil/sediment treatments, in situ groundwater treatments generally require longer time periods, and treatment progress can be difficult to verify. Pumping of water is required for ex situ water treatments; therefore, these treatments are more costly.

Specific thermal, biological, physical, and chemical treatment methods that can be applied to contaminated media at the release site (in situ) or following removal from the site (ex situ) for contaminant destruction/alteration, extraction/separation, or immobilization are briefly described in the table below.

Table 21: Environmental Containment and Remediation Options

Treatment Type	Description	*In Situ*	*Ex Situ*
Biological treatments (soil and water)	Biological treatments destroy organic compounds by stimulating microorganisms to grow and use the contaminants as a food source. A key benefit of bioremediation is its low cost, with little to no residual treatment needed. However, processes are generally slow, may be sensitive to environmental conditions, and may leave behind less degradable or more toxic substances. Remediation success has been achieved when treating petroleum hydrocarbons, solvents, pesticides, and wood preservatives. Biological treatments are not applicable to inorganic contaminants.	Soil, sediment: ▪ Bioventing ▪ Enhanced bioremediation ▪ Phytoremediation Water: ▪ Bioreactor ▪ Enhanced bioremediation ▪ Monitored natural attenuation ▪ Phytoremediation ▪ Biowall ▪ Enhanced *in situ* reductive chlorination	Soil, sediment: ▪ Biopiles ▪ Composting ▪ Landfarming

Treatment Type	Description	*In Situ*	*Ex Situ*
Physical/ chemical treatments[39] (soil and water)	Physical and chemical treatments use the properties of the contaminants or the contaminated medium to destroy (i.e., chemically convert) or separate out the contamination. Key benefits include cost effectiveness and short cleanup times which are dependent on surrounding environmental factors (i.e., soil/sediment composition). However, the processes may increase the ability of remaining contaminants to spread, and treatment residuals may require after action treatment or disposal.	Soil, sediment: ▪ Neutralization/pH control ▪ *In situ* chemical oxidation/reduction ▪ Electrokinetic remediation ▪ Fracturing ▪ Soil flushing ▪ Soil vapor extraction (SVE) Water: ▪ Neutralization/pH control ▪ Neutralization via flocculants, gelling agents, activated carbon, complexing agents ▪ *In situ* chemical oxidation/reduction ▪ Air sparging ▪ Bioslurping ▪ Directional wells ▪ Multiphase extraction ▪ In-well air stripping ▪ *In situ* activated carbon ▪ Permeable reactive barriers ▪ Dispersants	Soil, sediment: ▪ Soil washing Water: ▪ Air stripping

[39] https://frtr.gov/matrix/default.cfm; https://clu-in.org/

Treatment Type	Description	*In Situ*	*Ex Situ*
Thermal treatments (soil, water)	Thermal processes use heat to increase the volatility of (separate); burn, decompose, or detonate (destroy); or melt (immobilize) contaminants. Separation technologies such as thermal desorption and will have an off-gas stream that requires treatment. Destruction technologies such as incineration will typically have a solid (ash) and possibly a liquid residue that will require treatment or disposal. Ash may be suitable for use as clean fill on-site; if treatment occurs off-site, the ash may need to be pretreated before disposal in a landfill. Although a key benefit is short cleanup times, thermal treatments are often costly, particularly when used *ex situ*, due to energy and equipment needs. For these techniques, the residuals that require treatment or disposal are usually a much smaller volume than the original.	Soil, sediment: ▪ Electrical resistance heating ▪ Thermal conduction heating ▪ Steam enhanced extraction ▪ Thermally-enhanced SVE ▪ *In situ* combustion Water: ▪ Electrical resistance heating ▪ Thermal conduction heating ▪ Steam enhanced extraction ▪ *In situ* combustion (surface water)	Soil, sediment: ▪ Incineration ▪ Desorption

Treatment Type	Description	*In Situ*	*Ex Situ*
Air emissions/ Vapor phase treatments (air)	Air emission treatments include a host of technologies that remove industrial air emission contaminants prior to atmospheric release (e.g., air pollution control technologies like "scrubbers"). Many technologies focus on the removal of volatile organic compounds (VOCs). Air emissions treatments are likely effective only for indoor releases and, in some cases, off-gassing from volatile chemicals released into other media. A number of *in situ* remediation technologies including SVE, thermal treatment, *in situ* combustion, bioventing, and multiphase extraction as well as *ex situ* technologies such as air stripping, thermal desorption, incineration, biopiles, and composting generate a vapor stream that may require treatment. Enhanced *in situ* reductive dechlorination and *in situ* chemical oxidation also have the potential to generate gases that may need to be recovered and treated. A variety of treatment options based on physical (adsorption and condensation), chemical (oxidation), and biological (biodegradation) processes are available to treat the vapors generated by these remediation technologies.	▪ Adsorption, physical or chemical (e.g., granular activated carbon, GAC) ▪ Biodegradation, using biofilters (natural materials such as peat, wood chips, compost, sludge, sand, and soil, or engineered materials such as vermiculite, GAC, and diatomaceous earth pellets) ▪ Condensation ▪ Oxidation (thermal, catalytic, photocatalytic) ▪ Scrubbing (physical or chemical absorption)	

Treatment Type	Description	*In Situ*	*Ex Situ*
Containment [40] [41](soil and water)	Containment measures prevent or reduce the movement of contaminants that cannot otherwise be inactivated or removed because of potential hazards, undetermined or inaccessible sources, unrealistic costs, or lack of adequate treatment technologies. They can also be used as a "stop- gap" solution until long-term remedial actions can be implemented. For solid media, key benefits include low to moderate costs and quick deployment times; for liquid media, containment measures can be costly as they often require heavy construction. Containment measures do not lessen the toxicity, mobility, or volume of the contained substance and should be viewed as temporary; they require periodic inspections for settlement, leaks, erosion, corrosion, and invasion by deep-rooted vegetation.	Soil, sediment: ▪ Landfill cap, soil cap (single- and multi-layer) ▪ Sediment cap (single- and multi-layer, may include amendments) ▪ Dredging (may be treated/disposed ex situ) ▪ Excavation (may be treated/disposed ex situ) ▪ Diversion, diking, ditching, booming, fencing, damming, berming ▪ Sorbents (synthetic, organic, and inorganic Water: ▪ Booming, beach berming, diking, damming ▪ Sorbents	

[40] ExxonMobil. 2014. Oil Spill Response Field Manual. ExxonMobil Research and Engineering Company; ITOPF 2012. Response to Marine Chemical Incidents. Technical Information Paper 17. ITOPF Ltd., London, UK. Available at https://www.itopf.org/knowledge-resources/documents-guides/document/tip-17-response-to-marine-chemical-incidents/. ITOPF 2009. Are HNS Spills More Dangerous than Oil Spills? Interspill Conference & the 4th IMO R&D Forum, Marseille, France, May 2009. ITOPF Ltd., London, UK. Available at https://www.itopf.org/knowledge-resources/documents- guides/document/are-hns-spills-more-dangerous-than-oil-spills-2009; SONS 2017. Spill of National Significance: Public Affairs Reference. SONS Communications Coordination Workgroup. Available at https://www.nrt.org/sites/2/files/SPAR_FINAL_26Sept2017.pdf.

[41] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9768&p_table=STANDARDS. Standards – 29 CFR 1910.120 App C Part Number: 1910, Part Title: Occupational Safety and Health Standards, Subpart: H, Subpart Title: Hazardous Materials, Standard Number: 1910.120 App C, Title: Compliance guidelines. GPO Source: e-CFR; ExxonMobil. 2014. Oil Spill Response Field Manual. ExxonMobil Research and Engineering Company.

Treatment Type	Description	*In Situ*	*Ex Situ*
	Solidification and stabilization (S/S) technologies use both physical and chemical means to immobilize a contaminant. In S/S, various types of binders, additives, and chemicals are added to contaminated media to physically entrap the contaminant (e.g., encapsulation) or make it insoluble, thus reducing its ability to move through the environment. S/S treatment reagents are often used together, may be combined with other treatment methods, and may be used as interim or final remedial measures. S/S is best suited for metals and inorganic contaminants. A key benefit to S/S technologies is their ability to treat complex mixtures of wastes; they are also relatively quick to implement and low in cost (with the exception of vitrification). S/S measures usually do not lessen the toxicity of the treated substance and may increase the volume requiring management. S/S technologies use: ▪ Inorganic binders (cement, kiln dust, lime/fly ash, silicates) ▪ Organic binders (polymers, asphalt, clays, bitumen materials) ▪ Stabilization agents (phosphate, organoclays, activated charcoal)	▪ Pozzolan/portland cement stabilization ▪ Soluble phosphate stabilization ▪ Vitrification	▪ Bituminization ▪ Emulsified asphalt ▪ Modified sulfur cement ▪ Polyethylene extrusion ▪ Pozzolan/portland cement stabilization ▪ Sludge stabilization ▪ Soluble phosphate stabilization ▪ Vitrification

Selection of Treatment Approach

Certain containment and remediation methods have properties that make them poorly suited for use on certain types of materials or in certain types of ecosystems. The knowledge gained during event recognition and characterization activities (discussed in KPF 2, Recognize and Characterize the Incident) and throughout early response activities (discussed in KPF 4, Control the Spread of Contamination) will inform remediation course of action choices. Further, remediation strategies must be re- evaluated as conditions – and with them, method efficiencies – change throughout response and recovery. Often, multiple technologies are needed to fully remediate an entire site; several treatment technologies may be combined to form a “treatment train” at a site. In fulfilling the Emergency Planning and Community Right-to-Know Act (EPCRA), Clean Water Act, and Clean Air Act requirements, Responsible Parties(RPs)/facilities will provide much of the information needed to support containment and remediation/decontamination approach selection, such as the name and quantity of the chemical released, the media into which the chemical was released, and any actions taken to respond to and contain the release.

Rather than implementing a rigid regulatory framework for corrective action following a chemical release, the US Environmental Protection Agency (EPA) assists the RP and responders with choosing remediation strategies, providing access to resources detailing remediation/decontamination and containment techniques, procedures and equipment, including the availability of greener, more sustainable treatment options. Further, the EPA has developed guidance and policy documents to assist facilities conducting cleanups. When remediation needs go beyond the capabilities of the RP, the EPA (for inland releases) or US Coast Guard (for coastal releases) will assist as described in the Federal Preparedness, Response and Recovery section of this document.

Table 22: Table 17: Remediation and Containment Option Resources

Asset	Description	Agency/Owner
Citizen’s Guide Series to Cleanup Technologies	Set of 22 fact sheets that summarize cleanup methods used at Superfund and other sites.	EPA
Ecosystem Services at Contaminated Site Cleanups	Provides ecosystem services information for cleanup site teams. Valuable for discussing future land use options or design of a cleanup that is consistent with anticipated ecological reuse, depending on the regulatory authority of the cleanup program.	EPA
Groundwater Remediation at NPL Sites	Documents technologies used to restore groundwater. Includes select National Priorities List (NPL) sites where the remedial action objective (RAO) was to restore groundwater for use as a source of drinking water.	EPA

Asset	Description	Agency/Owner
Hazardous Waste Clean- Up Information (CLU-IN)	Provides information about waste remediation treatment and site characterization technologies.	EPA
In Situ Treatment Performance Monitoring: Issues and Best Practices	Discusses eight potential sampling/analytical issues associated with groundwater monitoring at sites where in situ treatment technologies are applied. Provides best practices to identify and mitigate issues that may affect sampling or analysis. Issues are grouped under three topic areas: issues related to monitoring wells; representativeness of monitoring wells; and post-sampling artifacts.	EPA
Interstate Technology and Regulatory Council (ITRC) Documents	A collection of documents ranging from technical overviews and case studies of innovative remediation technologies to technical and regulatory guidance documents for applying cleanup technologies.	ITRC
National Contingency Plan Product Schedule Toxicity and Effectiveness Summaries	Lists effectiveness of spill response products on different oils as well as lethal toxicity levels in marine life after exposure to particular products/mixtures of products.	EPA
Remediation Technologies for Cleaning Up Contaminated Sites	Collected information about remediation technologies used to clean up contaminated sites, including decision-making tools, documents, and websites maintained by state and federal agencies. These address contamination of soil, sediment, groundwater, and surface water, and include information about costs and cleanup time, green remediation techniques, and issues that may affect sampling and analysis.	EPA
Superfund Remedy Report (SRR)	Provides information and analyses on remedies EPA selected to address contamination at Superfund National Priorities List and Superfund Alternative Approach sites.	EPA
Federal Remediation Technologies Roundtable (FRTR) Technology Screening Matrix and Reference Guide	Allows users to screen 49 in situ and ex situ technologies for either soil or groundwater remediation. Variables used in screening include contaminants, development status, overall cost, and cleanup time. In- depth information on each technology is also available, including links to over 200 cost and performance reports.	Federal Remediation Technologies Roundtable

Appendix I. Medical Countermeasure Distribution Process: A Coordinated Response

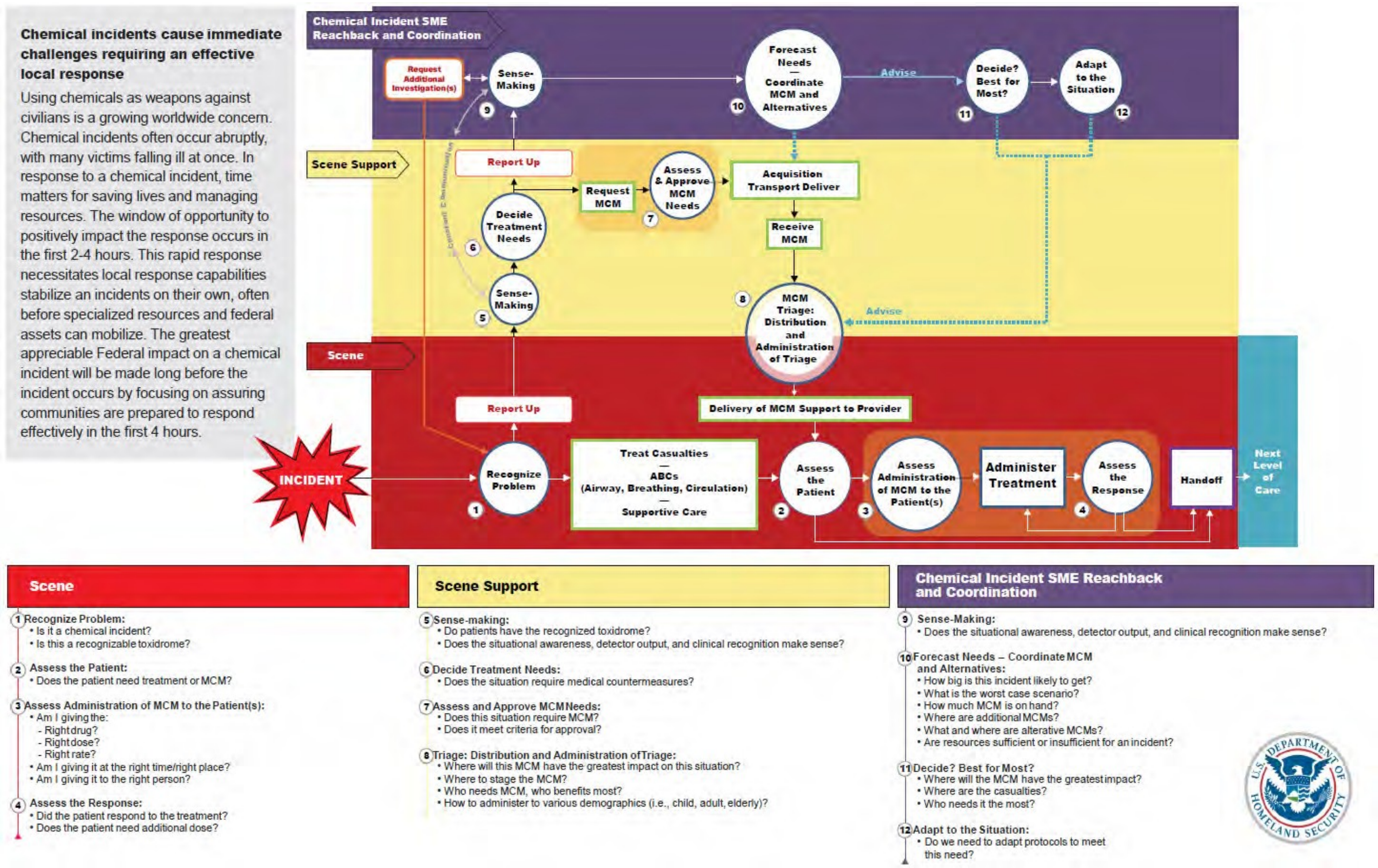

Figure 80: Image 80. Medical Countermeasure Distribution Process: A Coordinated Response

Appendix J. Acronym List

ACP	Area Contingency Plan
ADA	Americans with Disabilities Act
APHIS	Animal and Plant Health Inspection Service
APIO	Assistant Point of Contact
ASPR	Assistant Secretary for Preparedness and Response
BEOC	Business Emergency Operations Centers
CAA	Clean Air Act
CAFE	Chemical Aquatic Fate and Effects
CAMEO	Computer-Aided Management of Emergency Operations
CBRN	Chemical, Biological, Radiological, Nuclear
CBRNE	Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives
CDC	Centers for Disease Control and Prevention
CERC	Crisis & Emergency Risk Communication
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERT	Community Emergency Response Teams
CHEMM	Chemical Hazards Emergency Medical Management
ChemSTEER	Chemical Screening Tool for Exposures and Environmental Releases
CIDRAP	Center for Infectious Disease Research and Policy
CISA	Cybersecurity and Infrastructure Security Agency
CLU-IN	Clean-up Information
CMAD	Consequence Management Advisory Division
CMCU	Consequence Management Coordination Unit

COG	Continuity of Government
CONOPS	Concept of Operations
COOP	Continuity of Operations
COSS	Chemical Operations Support Specialist
CWA	Chemical Warfare Agent
CWA	Clean Water Act
DEFRA	Department for Environment, Food & Rural Affairs
DEST	Domestic Emergency Support Team
DHS	Department of Homeland Security
DMAT	Disaster Medical Assistance Team
DMORT	Disaster Mortuary Operational Response Team
DNU	Do Not Use
DOD	Department of Defense
DOT	Department of Transportation
DPMU	Disaster Portable Morgue Unit
DRC	Disaster Recovery Unit
DSSCA	Defense Support of Civil Authorities
DSTL	Defence Science and Technology Laboratory
D-SNAP	Disaster Supplemental Nutrition Assistance Program
DTRA	Defense Threat Reduction Agency
EAO	External Affairs Officer
EEI	Essential Elements of Information
E-FAST	Exposure and Fate Assessment Screening Tool
EMAC	Emergency Management Assistance Compact

EMS	Emergency Management System
EOC	Emergency Operations Centers
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPI	Estimation Program Interface
EPICode	Emergency Prediction Information Code
EpiX	Epidemic Information Exchange
ERHMS	Emergency Responder Health Monitoring and Surveillance
ERMA	Environmental Response Management Application
ESF	Emergency Support Function
ESI	Environmental Sensitivity Index
FAC	Family Assistance Center
FBI	Federal Bureau of Investigations
FCO	Federal Coordinating Officer
FDA	U.S. Food and Drug Administration
FDRC	Federal Disaster Recovery Coordinator
FEMA	Federal Emergency Management Agency
FIC	Family Information Centers
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FIOP	Federal Interagency Operational Plan
FMS	Federal Medical Station
FSC	Family Support Center
FTIR	Fourier Transform Infrared Spectroscopy
FRC	Family Reception Center

FRC	Federal Response Coordinator
GI	Gastrointestinal
GNOME	General NOAA Operational Modeling Environment
HazMat	Hazardous Material
HAZUS-MH	Hazards - United States (Multi-Hazard)
HAZWOPER	Hazardous Waste Operations and Emergency Response Worker Protection
HCC	Health Care Coalition
HCS	Hazard Communications Standards
HHS	U.S. Department of Health and Human Services
HIFLD	Homeland Infrastructure Foundation-Level Data
HIPAA	Health Insurance Portability and Accountability Act
HPAC	Hazard Prediction & Assessment Capability
HPP	Hospital Preparedness Program
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
IAPPG	Individual Assistance Program and Policy Guide
IC	Incident Commander
ICS	Incident Command System
ICIS	Integrated Compliance Information System
ICLN	Integrated Consortium of Laboratory Networks
ICP	Incident Command Post
ICWater	Incident Command Tool for Protecting Drinking Water
IDLH	Immediately Dangerous to Life or Health
IIOAC	Integrated Indoor-Outdoor Air Calculator
IMAAC	Interagency Modeling and Atmospheric Assessment Center

IMAT	Incident Management Assistance Team
IPAWS	Integrated Public Alert and Warning System
JFP	Joint Field Office
JIC	Joint Information Center
KPF	Key Planning Factor
LEPC	Local Emergency Planning Committee
LFA	Lead Federal Agency
LGR	Local Government Reimbursements
LVA	License Use Agreement
LVA	Low-Volatility Agent
MAC Group	Multiagency Coordination Group
MCM	Medical Countermeasure
MPRSA	Marine Protection, Research, and Sanctuaries Act
MOA	Memorandum of Agreement
MOD	Ministry of Defence
MoDI	Modeling and Data Inventory
MOU	Memorandum of Understanding
MRC	Medical Reserve Corps
NAHSS	National Animal Health Surveillance System
NARAC	National Atmospheric Release Advisory Center
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NDMS	National Disaster Medical System
NDRF	National Disaster Recovery Framework
NEI	National Emissions Inventory

NSSE	National Special Security Event
NEFA	National Fire Protection Association
NG	National Guard
NGO	Non-Governmental Organization
NIC	National Incident Commander
NIMS	National Incident Management System
NIOSH	National Institute for Occupational Safety and Health
NJIC	National Joint Information Center
NMRT	National Medical Response Teams
NPDES	National Pollutant Discharge Elimination System
NPDS	National Poison Data System
NPFC	National Pollution Funds Center
NPI	Non-Pharmaceutical Intervention
NPL	National Priorities List
NRC	National Response Center
NRCC	National Response Coordination Center
NRF	National Response Framework
NRP	National Residue Program
NRS	National Response System
NRT	National Response Team
NVRT	National Veterinary Response Team
NVS	National Veterinary Stockpile
OCIA	Oil/Chemical Incident Annex
OPA	Oil Pollution Act

OSC	On-Scene Coordinators
OSHA	Occupational Safety and Health Administration
OSLTF	Oil Spill Liability Trust Fund
PAO	Public Affairs Officers
PCI	Permit Compliance System
PID	Photo Ionization Detector
PIO	Public Information Officer
POTW	Publicly Owned Treatment Works
PPD	Presidential Policy Directive
PPE	Personal Protective Equipment
PSA	Public Service Announcement
PSA	Protective Security Advisor (CISA)
PSAP	Public Safety Answering Point
PTSD	Post-Traumatic Stress Disorder
QSAR	Quantitative Structure-Activity Relationship
QUIC	Quick Urban & Industrial Complex
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RDF	Rapid Deployment Force
RedDOG	Readiness and Deployment Operations Group
RHRC	Regional Hub Reception Center
RMP	Risk Management Program
RSEI	Risk-Screening Environmental Indicators
RP	Responsible Party

RRCC	Regional Response Coordination Center
RRT	Regional Response Team
RSF	Recovery Support Function
SAO	Senior Agency Official
SARA	Superfund Amendments and Reauthorization Act
SDS	Safety Data Sheet
SDWA	Safe Drinking Water Act
SENSOR	Sentinel Event Notification System for Occupational Risk
SERC	State Emergency Response Commission
SHARC	System for Hazard Assessment of Released Chemicals
SLTT	State, Local, Tribal, Territorial
SME	Subject Matter Expert
SNS	Strategic National Stockpile
SONS	Spill of National Significance
SOP	Standard Operating Procedure
SPR	Stakeholder Preparedness Review
TCCT	Trauma and Critical Care Teams
TEPC	Tribal Emergency Planning Committees
TERC	Tribal Emergency Response Commissions
THIRA	Threat and Hazard Identification and Risk Assessment
TIC	Toxic Industrial Chemical
TIM	Toxic Industrial Material
TPQ	Threshold Planning Quantity
TRI	Toxic Release Inventory

TSA	Transitional Sheltering Assistance
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facilities
UC	Unified Command
UCG	Unified Coordination Group
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USG	United States Government
USPHS	U.S. Public Health Service
VIC	Victim Information Center Teams
VIP	Victim Identification Program
VOAD	Voluntary Organizations Active in Disasters
VOC	Volatile Organic Compound
WEA	Wireless Emergency Alert
WISER	Wireless Information System for Emergency Responders
WMD	Weapon of Mass Destruction
WMD-CST	Weapons of Mass Destruction Civil Support Team
WMDSG	Weapons of Mass Destruction Strategic Group

Appendix K. Glossary of Terms

Acute effect: Health effect that occurs rapidly as a result of short-term exposures.

Aerosol: Fine liquid or solid particles suspended in a gas; for example, fog or smoke.

Aerosolization: The production of an aerosol/a fine mist or spray containing minute particles.

Agent: Historically, “agent” has referred to weaponized preparations of chemical or biological materials. This document follows that convention and refers only to chemicals used in deliberate attacks as “chemical agents” or “chemical warfare agents” (see also below); all others (no matter their hazard) are referred to simply as “chemicals” or “substances”.

Airborne hazard: Any harmful substance suspended in air that could lead to an exposure.

Asset: Structure or facility that has value and provides a service.

Animal: Animals include household pets, service and assistance animals, working dogs, livestock, fish, wildlife, exotic animals, zoo animals, research animals, and animals housed in shelters, rescue organizations, breeding facilities, and sanctuaries.

Boom: Physical barrier used to control the movement of a chemical substance. Booms are often used to control oil spills and are typically the first mechanical response equipment employed at a spill site.

Chemical detection technology: Any of a variety of both active and passive technologies that can detect one or more chemicals and record its concentration.

Chemical intoxicant: Any chemical, or its precursor, which through its chemical action on life processes can cause sensory irritation, temporary incapacitation, permanent harm, or death to humans or animals. This includes all such chemicals, regardless of their origin or of their method of production, and regardless of whether they are produced in facilities, in munitions or elsewhere.

Chemical warfare agent (CWA): A chemical substance that is intended for use in military operations to kill, seriously injure, or incapacitate people through its physiological effects. Excluded from consideration are riot control agents and smoke and flame materials. The agent may appear as a vapor, aerosol, or liquid; it can be either a casualty/toxic agent or an incapacitating agent.

Chronic effect: Health effect that occurs as a result of long-term exposure and is of long duration.

Cold zone: At an incident site, the uncontaminated area beyond the warm zone in which resources are assembled to support the response (green zone, support zone).

Containment: Mechanical actions taken to prevent the spread of a contaminant from a particular area or movement within the area.

Contamination: Deposition and/or absorption of chemicals on and by structures, areas, or materials and surfaces (e.g., soil, air, water, clothing, hair, skin) which renders them unfit for human use or dangerous to human and/or environmental health.

Contaminant dissolution: Chemical removal of surface contaminants from equipment by dissolving them in a solvent.

Critical infrastructure: Systems and assets, whether physical or virtual, so vital that the incapacity or destruction of such may have a debilitating impact on the security, economy, public health or safety, environment, or any combination of those matters, across any federal, state, tribal, territorial, or local jurisdiction. As established in the National Infrastructure Protection Plan, this includes the sectors of agriculture and food; drinking water and wastewater treatment systems; dams; public health and healthcare; emergency services; government and commercial facilities; defense industrial base; national monuments and icons; information technology; telecommunications; energy; nuclear reactors materials and waste; transportation systems; banking and finance; chemical; and postal and shipping.

Control zone: Area at a hazardous materials incident whose boundaries are based on safety and the degree of hazard. Control zones generally includes the hot zone (exclusion zone), warm zone (decontamination zone), and cold zone (support zone).

Corrosive: Able to destroy the texture or substance of a tissue by means of a chemical reaction.

Decontamination: Process of inactivating or removing a contaminant from humans, animals, plants, food, water, soil, air, areas, or items through physical, chemical, or other methods to meet a clearance goal. Decontamination applies to both disinfection and sterilization processes and generally occurs as part of cleanup/remediation.

Dependency: The one-directional reliance of an asset, service, system, network, or collection thereof, within or across sectors, on input, interaction, or other requirement from other sources in order to function properly.

Direct contact hazards: Chemicals that can be hazardous to human or animal health upon direct dermal exposure, such as by the touching of surfaces (clothing, floors, walls, seats, turnstiles, handrails, etc.) on which the hazardous chemical is present.

Dispersal: The distribution of particles of one substance in a continuous phase of another substance. The two substances can be in the same or different states of matter (solid, liquid, or gas). As a result of dispersal, the concentration of the distributed substance is lowered.

Dispersant: Chemical and physical treatments that speed the dispersion of a substance. In oil spills, dispersants are often surfactants and/or solvent compounds that reduce the interfacial tension between oil and water, allowing the oil to break up into small droplets that can be dispersed into the water column and that promote biodegradation.

Emergency Operations Center (EOC): Physical location at which the coordination of information and resources to support domestic incident management activities normally takes place. An EOC may be a temporary facility or located in a more central or permanently established facility, perhaps at a higher level of organization within a jurisdiction. EOCs may be organized by major functional disciplines (e.g., fire, law enforcement, and medical services), by jurisdiction (e.g., Federal, state, tribal, territorial, or local), or by some combination thereof.

Emergency respite site: Location along an evacuation route that can support transportation of assisted evacuees and self-evacuees.

Emergency shelter: Site that assists in providing immediate lifesaving and sustaining care until conditions stabilize and full services can be established at more permanent shelter (mass care) locations; they generally have limited supplies and services.

Emergency Support Function (ESF): The structure for coordinating federal interagency support for response to an incident.

Environmental sampling: Sampling conducted for the purpose of detecting the presence of a specific substance.

Evacuation: Immediate egress or escape of people from an area that contains an imminent threat, an ongoing threat, or a hazard to lives and property.

Evacuation assembly point: Temporary location set up for evacuation embarkation and transportation coordination.

Exposed: Individuals that have come into contact with a chemical substance.

Exposure: Contact with a chemical, either directly or via another substance contaminated with a chemical.

Exposure level: Measured or estimated amount of a substance (e.g., chemical) to which an individual or populations of individuals is exposed, usually expressed as concentration over a defined period (e.g., ppm for one hour).

Family Assistance Center (FAC): Facilities established 24-48 hours after an incident, that provide information about missing or unaccounted persons and the deceased and serve as a private "one-stop shop" of human services for affected populations.

Family Reception Center (FRC): Centralized, temporary locations set up immediately post-incident for families and friends seeking trusted/official sources of information about loved ones.

Fatality management: Coordination of several organizations (e.g., law enforcement, healthcare, emergency management, medical examiner, etc.) to ensure the proper recovery, handling, identification, transportation, tracking, storage, and disposition of human remains.

First responder: Designation for an individual who, in the course of their professional duties of responding to emergencies, and in the early stages of an incident, is responsible for the protection and preservation of life, property, evidence, the environment, and for meeting basic human needs.

Hazard: Something that is potentially dangerous or harmful, often the root cause of an undesired outcome.

Hazardous waste: Waste with properties that make it dangerous or capable of having a harmful effect on human health or the environment.

Hot zone: The area immediately surrounding the incident site in which primary contamination may occur (also known as Red zone, exclusion zone).

Hospital Family Information Center/Family Support Center (FIC/FSC): Healthcare facility-based location that provides initial support to families arriving after an incident that assist with reunification, notification, and providing information.

Incident: An occurrence, caused by either human action or natural phenomenon, that may cause harm and require action, which can include major disasters, emergencies, terrorist attacks, terrorist threats, wild and urban fires, floods, hazardous materials spills, nuclear accidents, aircraft accidents, earthquakes, hurricanes, tornadoes, tropical storms, war related disasters, public health and medical emergencies, cyber attacks, cyber failure/accident, and other occurrences requiring an emergency response.

Incident Commander (IC): Individual responsible for all incident activities, including the development of strategies and tactics and the ordering and release of resources. The IC has overall authority and responsibility for conducting incident operations and is responsible for managing all incident operations at the incident site.

Incident Command Post (ICP): The field location where the primary functions are performed. The Incident Command Post may be co-located with the incident base or other incident facilities.

Incident Command System (ICS): A standardized on-scene emergency management construct specifically designed to provide for the adoption of an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.

Industrial agent: Chemical developed or manufactured for use in industrial operations or research by industry, government, or academia. These chemicals are not primarily manufactured for the specific purpose of producing human casualties or rendering equipment, facilities, or areas dangerous for use by humans. Hydrogen cyanide, cyanogen chloride, phosgene, chloropicrin, and many herbicides and pesticides are industrial chemicals that also can be chemical agents.

Infrastructure: The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons.

Joint Information Center (JIC): Focal point for the coordination and provision of information to the public and news media concerning the Federal response to the emergency.

Large-scale incident: A designation to distinguish a significant event from day-to-day responses. This is generally an incident that because of the magnitude, complexity, toxic potency or deliberate nature requires federal assets and exceeds the response capability of state, tribal, territorial, and/or local agencies.

Lead Federal Agency (LFA): The federal agency that leads and coordinates the overall federal response to an emergency.

License Use Agreement: An agreement that allows one party (the licensee) to use the property of the owner (the licensor).

Local government: Public entities responsible for the security and welfare of a designated area as established by law. Includes county, municipality, city, town, township, local public authority, school district, special district, intrastate district, council of governments, regional or interstate government entity, or agency or instrumentality of a local government; an Indian tribe or authorized tribal organization, a native village or native cooperation; or a rural community, unincorporated town or village, or other public entity; state governments are separate entities and are not included in the definition of local government.

Media: Refers to the air, water, soil, or surface that has been or is potentially contaminated by a chemical substance.

Medical countermeasure (MCM): A regulated pharmaceutical product, medical device, or intervention used to combat the effects of chemical, biological, radiological, or nuclear incidents.

Memorandum of Agreement (MOA): A conditional agreement where the transfer of funds for services is anticipated between signatories; these signatories have agreed to work cooperatively together toward an agreed upon objective.

Memorandum of Understanding (MOU): A non-enforceable document that outlines the intentions of its signatories to pursue a common goal.

Mitigation: Activities designed to reduce or eliminate risks to persons or property, or to lessen the actual or potential effects or consequences of an incident. Mitigation measures may be implemented prior to, during, or after an incident.

Model: A physical, conceptual, or mathematical approximation of a real phenomenon.

Morbidity: The incidence of illness/injury in a population and/or a geographic location.

Mortality: The incidence of death or the number of deaths in a population and/or a geographic location.

National Incident Management System (NIMS): System mandated by HSPD-5 that provides a consistent, nationwide approach for federal, state, tribal, territorial, and local governments; private sector; and non-governmental organizations to work effectively and efficiently together to prepare for, respond to, and recover from domestic incidents, regardless of cause, size, or complexity.

National Response Framework (NRF): The Homeland Security Act of 2002 and the HPSD-5 directed the DHS to develop an NRF, a guide to how the nation responds to all types of disasters and emergencies.

Natural attenuation: A variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater.

Nerve agents: Substances that interfere with the proper function of the nervous system.

Neutralization: Chemical and physical treatments neutralize, solidify, precipitate, etc. the substance, reducing its risk to human and environmental health.

Non-Pharmaceutical Intervention (NPI): A public health intervention that people and communities can take to help prevent spread of illness or contamination. Examples of NPIs include personal protective equipment, social distancing, quarantine, travel restrictions, school closures, product recall, evacuation, and shelter-in-place.

Nonpersistent: Describes a chemical substance that dissipates quickly in the environment and is therefore considered to be a short-term hazard. For chemical agents, nonpersistent chemicals lose their ability to cause casualties 10 to 15 minutes after release.

Normalcy: Pre-event condition and/or operation status.

Oxidizer: A chemical which supplies its own oxygen, and which helps other combustible material burn more readily.

Persistent: Describes a chemical substance that is resistant to evaporation and environmental degradation through chemical, biological, and phytolytic routes and therefore is likely to pose long-term hazards to humans, animals, and/or the environment. Persistent chemicals often resist decontamination efforts. For chemical agents, persistent chemicals retain casualty-producing effects for an extended period, usually anywhere from 30 minutes to several days after release.

Personal Protective Equipment (PPE): Protective clothing, helmets, gloves, face shields, goggles, facemasks and/or respirators or other equipment designed to minimize exposure and protect the wearer from injury due to chemical exposure or the spread of contamination.

Post-Traumatic Stress Disorder (PTSD): A mental health condition triggered by either experiencing or witnessing a traumatizing event.

Populace: All the inhabitants of a place; population.

Presidential Policy Directive (PPD): Mechanism for issuing Presidential decisions on national security matters.

Prevention: Actions taken to avoid an incident or to intervene to stop an incident from occurring. Prevention involves actions taken to protect lives and property.

Primary contamination: The contamination of persons or equipment as a result of direct contact with a released substance.

Public Health Emergency (PHE): An incident, either natural or manmade, that creates a health risk to the public.

Reachback: Products, services, equipment, material, or human resources including subject matter experts from organizations that are not forward deployed.

Recovery: The development, coordination, and execution of service- and site-restoration plans; the reconstruction of government operations and services; individual, private-sector, non-governmental, and individual assistance programs to provide housing and promote restoration; long-term care and treatment of affected persons; additional measures for social, political, environmental, and economic restoration; evaluation of the incident to identify lessons learned; post- incident reporting; and development of initiatives to mitigate the effects of future incidents.

Recovery outcome: High-level desired end-state of a recovery effort, such as minimizing economic disruption and/or minimizing impacts to public health and safety.

Resuspension: A renewed suspension of insoluble particles after they have been precipitated, such as particles in water.

Regional Hub Reception Center (RHRC): Facilities where evacuees can receive assistance in identifying the most appropriate shelter location for their needs.

Remediation: Removal of pollution or contaminants from water and soil. Also, the reversing or stopping environmental damage from such pollution or contaminants.

Residual contamination: Amount of contaminant remaining after an area has been decontaminated. Levels of residual contamination may be below technological detection capabilities.

Resources: Personnel and major items of equipment, supplies, and facilities available or potentially available for assignment to incident operations and for which status is maintained. Available or potentially available funding may also be considered a resource.

Response: Actions taken immediately after discovery of a potential or actual occurrence of an incident, generally including Notification and First Response.

Restoration: The process of renovating or refurbishing a facility, bringing it back to an unimpaired or improved condition after decontamination, and making a decision to permit occupants to return.

Rinsing: Removes contaminants through dilution and solubilization, and may follow dissolving and surfactant treatments.

Risk: Probability that a substance or situation will produce harm under specified conditions. Risk is a combination of two factors: (1) the probability that an adverse incident will occur (such as a specific illness or type of injury); and (2) the consequences of the adverse incident.

Risk assessment: Gathering and analyzing information on what potential harm a situation poses and the likelihood that people or the environment will be harmed. A methodological approach to estimate the potential human or environmental risk of a substance that uses hazard identification, dose–response, exposure assessment, and risk characterization.

Risk communication: Interactive process of exchange of information and opinion among individuals, groups, and institutions. It often involves multiple messages about the nature of risk or expressing concerns, uncertainties, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management.

Risk management: Process of identifying, evaluating, selecting, and implementing actions to reduce risk to human health and to ecosystems. The goal of risk management is scientifically sound, cost-effective, integrated actions that reduce or prevent risk while taking into account social, cultural, ethical, political, and legal considerations.

Sampling: Act of collecting representative portions of environmental materials and surfaces that help to specify the number, type, and location (spatial or temporal) of contamination.

Sampling and analysis plan: Plan that describes the methods, strategies, and analyses to be used for sampling a contaminated site.

Secondary contamination: Contamination of healthcare or other responding personnel or equipment as a result of contact with a contaminated person (victim/survivor), their personal effects/clothing, or equipment.

Service: The functions and capabilities provided by an asset or set of assets to the economy, government, or society.

Screening: Systematic examination or assessment, done especially to detect an unwanted substance, attribute, person, or undesirable material.

Shelter (mass care): Facility where evacuees receive disaster services from government agencies and/or pre-established volunteer organizations.

Shelter-in-place: Used when people are in or near an area that contains an imminent threat, an ongoing threat, or a hazard to lives and property, and evacuation would cause them to be at greater risk or cannot be performed.

Simulation: Imitation of characteristics, processes, or systems over time using another system.

Site characterization: Process of gathering site-specific data, including overall descriptions of the site, material types present at the site, potential human exposure pathways, and environmental conditions to estimate the extent of contamination. Site characterization occurs as an early step in consequence management.

Solidifier: Physical or chemical means used to change the physical state of a contaminant (such as from a liquid to a solid), immobilizing it and/or making it insoluble. Used to prevent contaminant spread.

Solution: A homogeneous mixture of two or more substances, usually liquid.

Solvent: A substance that dissolves another substance.

Sorption: Chemical and physical treatments that absorb or adsorb a substance, enabling its collection for disposal and in some cases (for example, in some oil spills), recovery.

Stafford Act Declaration: Disaster or emergency declaration invoked by the President of the United States in response to an incident either as requested by the states and/or by a federal agency requesting federal-to-federal assistance.

Stakeholder: Person who has a share or an interest in incident resolution and is representative of the affected public.

Stakeholder working group: A group that collectively works to represent and promote local interests, relating local preferences and concerns.

Strategic National Stockpile (SNS): Managed HHS ASPR, a stockpile composed of pharmaceuticals (e.g., medications, antibiotics, etc.) and medical supplies (e.g., equipment, surgical items, etc.) that may be required to control and/or respond to a public health emergency.

Surfactant: Often a detergent used to augment physical cleaning methods; surfactants work by reducing adhesion forces between contaminants and the surface being cleaned, and by preventing redeposit of the contaminants.

Supply chain: A system of organizations, people, activities, information, and resources involved in supplying a product or service to a consumer/end user.

Syndromic surveillance: Tracking of illness indicators that occur before clinical diagnosis confirmation, such as chief complaint data from urgent medical visits, over-the-counter medication purchases, school absenteeism rates, and key word (e.g., "fever", "vomit") presence on social media platforms. Syndromic surveillance is used for early detection of a health hazard incident and for trend monitoring.

Therapeutic: Product intended to diagnose, cure, mitigate, treat, or prevent illness, injury, disease or effects on the structures and functions of the body.

Toxic: Having the ability to harm the body, especially by chemical means.

Toxic Industrial Chemical (TIC): Any industrial chemical hazard that is toxic and/or lethal and not designed specifically for military purposes; however, a TIC may be employed as a chemical warfare agent.

Toxic Industrial Material (TIM): Substance (i.e., chemical, explosive, radiological) that when delivered in sufficient quantities may produce a toxic effect to humans, animals, and the environment. Although not designed specifically for military purposes, a TIM may be employed as a chemical warfare agent.

Toxidrome: A group of signs and symptoms constituting the basis for a diagnosis of poisoning.

Toxicity: Degree to which some agent is poisonous or harmful, often inversely related to the amount of the agent that causes the harmful or fatal effect(s).

Triage: The sorting of and allocation of treatment to patients, especially battle and disaster victims, according to a system of priorities designed to maximize the number of survivors. Also, the sorting of patients (as in an emergency room) according to the urgency of their need for care.

Uncertainty: Imperfect knowledge concerning the present or future state of the system under consideration; a component of risk resulting from imperfect knowledge of the degree of hazard or of its spatial and temporal distribution.

Unified Command (UC): Application of ICS used when there is more than one agency with incident jurisdiction or when incidents cross political jurisdictions. Agencies work together through the designated members of the UC to establish their designated IC at a single Incident Command Post and to establish a common set of objectives and strategies and a single Incident Action Plan (IAP).

Volatile: A substance that can be defined as evaporating readily at normal temperatures. Volatility describes how easily a substance will vaporize (turn into a gas or vapor).

Vapor density: Weight of a volume of pure vapor or gas (with no air present) compared to the weight of an equal volume of dry air at the same temperature and pressure. A vapor density less than 1 (one) indicates that the vapor is lighter than air and will tend to rise. A vapor density greater than 1 (one) indicates that the vapor is heavier than air and may travel along the ground.

Vapor pressure: Pressure at which a liquid and its vapor are in equilibrium at a given temperature. Liquids with high vapor pressures evaporate rapidly.

Vapor suppression: Chemical and physical treatments (i.e., sealing with foam) that suppress vapor generation by volatile substances.

Viscosity: Measure of a liquid's internal resistance to flow. This property indicates how fast a material will leak out through holes in containers or tanks.

Voluntary agency liaison: Official that supports and works in collaboration with voluntary organizations.

Warm zone: At an incident site, the area that surrounds the hot zone and contains the area where victims and responding team members and their equipment are decontaminated (yellow zone, contamination reduction zone).

Whole community: Concept that includes persons, businesses, faith-based organizations, non-profit groups, schools and academia, and all levels of government.