Female: Every year hazardous emergencies take their toll on dollars and human lives. While some losses are unavoidable, adding shelter-in-place to emergency plans can help businesses cope with a fast-moving toxic cloud when there isn't time to evacuate. No one can predict the exact conditions or who will be around at the time of a hazardous chemical release. This training is to help facility managers, safety officers, and others who manage emergencies understand how sheltering works, identify areas in buildings for sheltering occupants, and develop shelter-in-place plans for short-term chemical vapor releases.

Shelter-in-place is a standard protective action that has been used throughout the United States for years. Fire departments and emergency managers have used shelter-in-place for toxic fumes from chemical plant fires to railroad tank spills. You might be asked to shelter-in-place because of an accident today. Your business may already have an all hazards or business continuity plan that includes evacuation as a protective action. Adding a shelter-in-place strategy can increase your options for protection during emergencies.

To help you understand shelter-in-place as a protective action, we will describe why shelter-in-place works, when sheltering is appropriate, how to integrate shelter-in-place with existing emergency or contingency plans, how to select and prepare appropriate shelter spaces in your building, how to identify the tasks associated with the shelter-in-place process, and what to do when sheltering is terminated. The protection offered by sheltering against airborne clouds of hazardous substances can be substantial. For particular clouds of long duration such as outdoor air pollution, pollen, and soil particles, concentrations inside buildings are generally 10 to 50 percent of the outdoor air concentrations.

For clouds of short duration, 15 minutes or less, the exposure may easily be as low as 5 percent of that outside. Once a cloud with hazardous materials has passed, the concentration that has built up inside the shelter decreases with time. However, occupants must exit or vent the shelter to prevent further exposure. The concentration of contaminated air within the shelter relative to that outside depends on the rate at which air is exchanged with the outdoors called the air exchange rate, the removal of the contaminant as it passes between the outdoors and the shelter, and the deposition rate of the contaminant within the shelter.

The air exchange rate will vary depending on the shelter's volume, the tightness of the doors and windows, the existence of vertical

routes such as chimneys, flues, and elevator shafts, whether heating ventilation and air conditioning systems are operating, the indoor/outdoor temperature differences, the greater the difference the higher the infiltration rate, wind speed and the orientation of the building to those winds, as higher wind speeds increases the infiltration rate, and the sheltering of the structure by surrounding trees and buildings.

The amount of contaminant filtered out as air enters the building is affected by the tightness and fit of the doors and windows, the size of the contaminant if a particulate, the velocity and turbulence of the airflow within the shelter, and the area and nature of the shelter's interior surfaces. A contaminant will remain in a building for the same reasons unless the structure is vented thoroughly. Preparing to shelter-in-place is relatively easy. The key pieces to an effective shelter-in-place plan are preparation, teamwork, and practice.

Female: Why would a business develop a plan to shelter-in-place?

Female: Because shelter-in-place is quickly implemented in a fast-paced event when evacuation would take much longer. It provides temporary protection from airborne chemical clouds, which pass by in less than an hour. It's preferred when weather conditions are unfavorable for evacuation. It's less disruptive to your business processes, and it's often less costly than evacuation. However, if the chemical release will last several hours and everyone can leave the area before the hazardous cloud arrives, it's better to evacuate. If the cloud has a high concentration of vapors that are flammable, explosive, or that react dangerously with common substances like water, officials may order evacuation anyway.

Female: So what about liability?

Female: Liability and insurance concerns should be discussed with your attorney or insurance representative during the initial planning stages. These issues are too complex and situation-specific to be resolved here.

Female: So we should be concerned about dangerous chemicals released in the air. I've thought about other hazards but not much about that one.

Female: Not many people consider the implications of airborne hazards until they experience such an event, but managing a business involves anticipating risks and identifying vulnerabilities to

safeguard personnel, products, and operations and then seeking to reduce the impacts of hazards. And in today's world, hazards that once happened accidentally may now be intentionally created.

Male: So what are the basic shelter-in-place procedures?

Female: Basically, shelter-in-place means stop what you're doing and go inside. Shut, listen, and leave. Once notified to shelter-in-place, occupants stop their activities, go inside if outdoors, and proceed to a preselected location inside a structure. Everyone should be told that the building will be closed in a certain timeframe, such as in three minutes, and that no one will be allowed in or out until authorities sound the all clear signal.

Female: Attention everybody. The doors are gonna be locked in three minutes.

Female: People then go to the preselected sheltered areas, shut doors and windows, and if not done ahead of time seal leaky areas with duct tape and plastic against infiltration. Then they listen to emergency broadcasts on radio or television to find out when it is safe to exit the shelter, and finally, they leave when told to do so by authorities usually going to a preselected site so that everyone can be accounted for.

Male: Sounds simple enough. Is that all?

Female: Some contaminated air may have seeped into the building while the vapor cloud passed, so the structure should be thoroughly vented. Venting the structure will replace the contaminated inside air with clean outside air. The only time it is not necessary to vent is when emergency officials determine the building was not actually exposed to the hazardous material, something that might happen if the wind blew the cloud away from the building or heavy rain washed the contaminants out of the air before it reached the building.

Male: How do I go about developing a plan?

Female: It's important to designate one or more persons who can authorize shelter-in-place and shutdown. Those people will likely be the same ones who can authorize an evacuation. In developing a plan, it's also helpful to include both upper management and employees, especially those familiar with engineering or safety. This is because shutting down and restarting heat and air conditioning

units can be a very complicated procedure, and there may be some critical operations that require special considerations.

Let's walk through the steps. First you should select appropriate areas to use as shelter locations. Make sure the shelter provides at least 10 square feet of floor space per person to provide ample oxygen for a five-hour period assuming a normal breathing rate while resting. Officials should not recommend that people shelter for more than one to two hours, because this strategy is to protect against short-term releases.

Rooms that are ground level or above with minimal connections to the outside of a building make the most effective shoulders. The ideal room will not have windows or exterior doors or vents to the outside. If your business has an emergency power supply such as a backup generator, then some lighting in the shelter and at least one electrical outlet should be on the emergency power circuit. A telephone line in the shelter will allow a convenient alternate voice and computer capability.

Next, prepare an emergency kit for shelter use and designate a person to retrieve it when needed. Most emergency kits contain similar stocks. At a minimum, the shelter-in-place kit should include portable battery-operated radio or TV with extra batteries in case of a power outage, a radio or TV that plugs into a wall socket is desirable if power exists, flashlight and extra batteries, portable telephones, blankets or large towels one for each expected occupant, bottled water and snacks, a first aid kit, plastic sheeting precut to cover windows, doors, and ceiling vents, duct or ceiling tape to secure plastic to walls, cover vents, and seal beneath doors and other areas of infiltration.

The whole building doesn't need to be sealed, just the actual shelter place. Other items might include office supplies. Remember that some people may want to bring their portable computers to the shelter, so several wall outlets are desirable. Someone should be assigned to record who is in the shelter and to make sure everyone is out of the building when it's being vented, and they should plan to periodically check the kits to replace outdated supplies.

Then, identify who will be responsible for each task. You will already have decided who can authorize shelter-in-place. The same person may be the one to issue the warning to take shelter. The usual choice is a manager, owner, or CEO, but it could be your safety officer or managers responsible for certain groups or areas

of the facility. If you have a 24/7 operation, you will need to designate a person for each shift. The person should be very familiar with the notification elements of the emergency plan. This may include initiating telephone call-downs as well as specialized warnings to make sure everyone, including those with disabilities, is informed of the decision to shelter.

Then identify the people responsible for locking doors, windows, and other entrances to block outside air from entering the structure, shutting down external HVAC systems or resetting air to recirculate only, placing placards at business entrances to indicate the business is closed for the duration of the emergency, ensuring dangerous or critical operations are secured, sealing doors or other openings in the shelter space with duct tape and plastic as necessary, accounting for persons in the shelter space and determining what to do if some employees, customers, or visitors remain unaccounted for, monitoring official announcements advising when to leave the building, and ensuring everyone sheltered evacuates to a preselected site, venting the structure, and determining when it is safe for employees to return to the building.

It also makes sense to select an off-site point of contact employees can call to learn when they can return to work or where they should go if the building cannot be reoccupied right away. You should determine what to do after leaving the shelter and the approximate time needed to purge the structure of contaminated air. Some managers may want employees to go to a designated area to make sure everyone is safe and accounted for.

Regularly train personnel and employees through periodic drills or exercises, and finally, evaluate your plan yearly when management teams change or when physical structures are modified. It's really not that difficult. Often existing emergency plans can be altered to include shelter-in-place.

Male: Who will tell me to shelter people in my business, and this all sounds like it'll take time to accomplish? Will I receive notice in time to do all the things you just described?

Female: In most communities, emergency officials will issue warnings to evacuate or shelter-in-place. Sometimes that warning comes directly through specialized warning systems such as indoor alert systems, tone alert radios, or telephone call-down systems. Or you may be told to take shelter by police or firefighters using public address systems. Usually the authorities who issue warnings will determine when it's safe to leave shelters. However, they may use

other methods such as broadcasting an all clear message over the radio or a local television station.

That's why it's important to monitor local radio stations when you are in the shelter. Some hazardous facilities use sirens to notify nearby residents and businesses to shelter-in-place. Those same sirens may be used to signal an all clear message when the danger is over.

Male: I can see some problems with getting my employees to shelter-in-place at work during an emergency. I mean they'll be worried about their families, and what about the customers? Can we force them to shelter-in-place?

Female: You're right. A shelter plan for a business or commercial facility involves both planning and cooperation from employees. You probably can't force people, employees or customers, to stay in shelter-in-place. You'd better have a very strong and persuasive warning message prepared to get them to comply. Make sure everyone knows that after the building is closed that no one will be allowed in or out until authorities sound the all clear signal.

Male: Well, how will I know how many people to plan for?

Female: Well you know how many employees there are, but customers are another matter. Consider using your marketing experts to determine average and extreme customer variations and peak loads, and you should decide whether walk-ins should be included in your plans. You may have to think about designating more than one room as a shelter.

Male: Are you really telling me that I can provide protection for people in this environment?

Female: Some commercial structures have characteristics that make sheltering in place more difficult. Dropped ceilings, elevator shafts, heights that penetrate exterior walls, or complex HVAC systems. Building engineers or the local fire marshall can help select the best space for sheltering in your building, and there are some new products on the market such as interior collected protection systems that provide temporary shelter inside buildings. These shelters use positive pressure filtration systems to remove harmful vapors or particles from the air providing protection to those inside. This shelter will protect up to 25 people. Smaller family size units are also available. Several people can rapidly assemble these units in minutes.

Male: Will sheltering-in-place protect against a dirty bomb?

Female: You're talking about a radiological dispersion device that contains some radioactive material that would be dispersed when a bomb explodes. The hazards associated with a dirty bomb explosion are radioactive aerosols and particles, radiation, and heat and debris from the blast. The three elements that protect against radiation from a nuclear explosion are time, distance, and shielding. Sheltering-in-place provides some temporary shielding from radiation released from a dirty bomb, but it is not intended for long-term protection from a high-altitude nuclear explosion that would spread radioactive material over a large area for an extended period of time. Sheltering as discussed here will reduce the hazards from inhalation of radioactive aerosols and particles produced by the explosion of a dirty bomb.

Male: You see I can't just shut down operations on a moment's notice. It takes over a day to do that.

Female: Shutting down all plant operations may not be possible or may require specially trained operators or engineers who are not always on site. Businesses with critical operations that require continued oversight or management may need to consider other actions such as providing those employees with personal protective equipment and training in its use.

Male: Some operations or facility security could be compromised.

Female: Security should be addressed in the planning stages. Most business continuity plans routinely address power outages and other losses that affect operations or security. Some business plans call for an alternative communication center or an off-site storage location for important documents.

Male: How can we be assured our assets will be protected?

Female: Some businesses may need to protect their critical or valuable assets as well as people in an emergency. These businesses should develop a section in their security plan that addresses asset protection during any emergency in which they are advised to evacuate or shelter-in-place.

Male: We've always promoted evacuation for emergencies.

Female: Many emergency plans call for evacuation without providing other options. If you decide to add a shelter-in-place strategy, changes

should be discussed with all personnel so everyone understands why sheltering will be used for certain events. Employees should be encouraged to discuss the changes with their family and coworkers.

Male: I'm sceptical my boss will go along with shelter-in-place.

Female: Senior management may not view sheltering as appropriate and thus not support it. Bringing upper management in during the initial planning stages is critical. Giving managers actual examples of when customers were protected by sheltering might help convince them that no business is immune to sudden airborne hazards where evacuation just won't work.

Female: So can we do anything else ahead of time for sheltering-in-place?

Female: You could enhance the protection your building offers by systematically reducing air infiltration into the structure, cocking seams, sealing around pipes, or adding airlock entry systems will slow the penetration of air into the structure and likely increase energy efficiency. Some facilities have elevated their HVAC systems above ground or moved them to a more protected location to keep them away from potential ground-level emissions.

You can install special carbon filters to clean incoming air before it is dispersed into a building or recirculated. Others have installed single override switches for HVAC systems to be used only in emergency shutdowns. Such retrofitting measures may also reduce the facilities vulnerability to terrorist acts. If you do decide to retrofit your system, be sure to consult a qualified HVAC engineer.

Female: My daughter attends school near an army post where chemical weapons are stored. The school library is over-pressurized. How does that work?

Female: A pressurized sheltering system draws in and filters extra air so that the air pressure inside a building is slightly higher than that outside. The pressure of this additional clean air blocks contaminated air from seeping in. Pressurized shelters provide a very high level of protection against specific chemicals. In schools with such systems, students enter the designated over-pressurized space and remain there with the doors sealed until the all clear signal is issued. Unless there is an airlock entry, these systems are compromised if people enter the shelter after it is sealed. Parents are told not to retrieve their children, because they are amply protected in this way.

Female: So you're saying I might need to get an outside vendor to install specialized systems to shelter-in-place?

Female: You should remember that most buildings provide some protection against outside airborne hazards. You may have some areas that have far less air infiltration than others such as a secured storage room. You may be surprised by your building's protection level if the windows are permanently sealed or corridors have fire doors that close with a tight seal. On the other hand, the space above drop ceilings in commercial buildings is a notorious source of air leakage. The key is to inventory your building and proceed from there.

Airborne hazards produced inside a building can actually be more dangerous than an outside release. Not only can higher concentrations result from an inside release, but the hazard persists longer, especially if no venting occurs. When a toxic material is released inside a building, all occupants should evacuate as quickly as possible. Sheltering-in-place is appropriate only if the hazard can be confined to a specific portion of the building away from the shelter area.

Male: So if I prepared a shelter-in-place, how will I know when to implement it? Should I get a detector?

Female: Reliable commercial detectors for chemical or biological warfare agents are not practical for businesses. You will likely have to rely on emergency officials to advise you when to implement shelter-in-place. The army and local communities involved in the Chemical Stockpile Emergency Preparedness Program, or CSEPP, have developed state-of-the-art systems to rapidly warn surrounding residents and businesses of a vapor release of a chemical warfare agent. Many communities also have call down or reverse 911 warning systems to alert specific facilities of emergencies.

Female: So using shelter-in-place requires planning. Are there any special considerations?

Female: Communications are important. Talk with your employees about sheltering-in-place plans. Managers may not be aware of each employee's special equipment or physical needs. Assign or recruit employees for specific tasks. Some managers assign responsibilities for certain work groups or for areas where customers or vendors may be located to personnel normally working in those areas. In facilities operating 24 hours 7 days a

week, each shift should have a designated employee familiar with the plan and available in an emergency. Also, talk to other businesses. If you share a common structure, you may be able to coordinate or combine your shelter-in-place plans.

Female: What do you think about preparing warning messages ahead of time?

Female: Attention, attention. This is not a test.

Female: Having a warning message for alerting employees and customers written before the event and adding details at the time of the emergency avoids last minute confusion about what to say. It's also a good idea to prepare the printed placards for doors and windows. Prepared messages should inform employees and customers that the facility is closing and where shelter areas are located. The message should also stress that the facility will not be reopened until an official all clear notification is made. Some customers and employees may choose to leave, and they should know they can't return until the facility is reopened. You should discuss with your insurance agent and local representative your obligations for customer safety.

Male: Should employees do anything special?

Female: Employees should be encouraged to keep a personal emergency kit near their workplace if they require special medical supplies or have special needs. Employees with disabilities who would have difficulty getting into the shelter should have a buddy assigned to help them. In multi-storied structures, this may mean having an emergency escape chair to carry them to the safe room either up or down stairs. Such actions are necessary for evacuations and should be part of the overall emergency plans.

Male: What about employees contacting families?

Female: Telephone numbers of essential contacts should be included in emergency kits of your employees. For example, you may have to inform your customers of a delay in shipping. Since local phone networks often become jammed in an emergency, encourage your employees to select an emergency telephone contact outside the affected area that family members can call. Once in the shelter, telephone calls should be limited to maintain free lines for emergency responder's use.

Male: What are you supposed to do while in the shelter space?

Female: What you do inside the shelter varies. It is important that occupants remain as calm as possible. One thing you can be sure of is that everyone in the shelter will be anxious for news about the emergency. Training and conducting exercises for sheltering will familiarize employees with sheltering procedures and give them an idea of what to expect in an actual emergency. Encourage employee questions during drills. Remember that sheltering-in-place is a short-term solution and that business and other activities can often be resumed shortly after the building is vented.

Female: Will it be safe at that point to return to the building?

Female: It's unlikely that a chemical vapor will leave deposits on furniture or other surfaces. This is generally a concern only for specialized or critical care facilities or in the event of a biological agent release. If this is a concern, your plan should include a contact such as a local HazMat unit, local or state healthy agency, or a certified vendor to verify the structure is safe to reoccupy. There is no way you can control when a chemical agent will be released accidentally or intentionally into the environment. What you can control is the degree of disruption it causes by preparing and exercising a shelter-in-place plan. Whether or not you use it, shelter-in-place provides an essential option in the face of dangerous and fast-moving events.

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