Chapter 7: Safety and Emergency Action Plans

Accidents and injuries don’t just happen, they are caused. Behind every accident is a chain of events that leads up to an unsafe act, unsafe conditions, or a combination of both. Safety in the workplace should be everyone’s concern. Communication between supervisors and employees generates ideas and safety awareness that leads to accident prevention. Safety programs, safety manuals, and safety meetings are essential in providing the lines of communication that lead to a safe, accident-free workplace.

Dangerous situations can be associated with five main gases that are produced in livestock and poultry buildings and manure storage structures. These gases are listed in Table 7-1, along with some of their characteristics. All of these are colorless.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Odor</th>
<th>Density</th>
<th>Health Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia (NH₃)</td>
<td>Pungent</td>
<td>Lighter than air</td>
<td>Irritation to eyes and nose. Asphyxiating at high levels.</td>
</tr>
<tr>
<td>Carbon Dioxide (CO₂)</td>
<td>None</td>
<td>Heavier than air</td>
<td>Drowsiness, headache. Can be asphyxiating.</td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>None</td>
<td>Heavier than air</td>
<td>Headache, chest pains, potential for problems with developing fetuses. Can be asphyxiating.</td>
</tr>
<tr>
<td>Hydrogen Sulfide (H₂S)</td>
<td>Rotten-egg smell</td>
<td>Heavier than air</td>
<td>TOXIC: causes headache, dizziness, nausea, unconsciousness, death.</td>
</tr>
<tr>
<td>Methane (CH₄)</td>
<td>None</td>
<td>Lighter than air</td>
<td>Headache, asphyxiating, explosive in 5% to 15% mixture methane with air.</td>
</tr>
</tbody>
</table>

**AMMONIA**

Ammonia (NH₃) is released from fresh manure and urine and during anaerobic decomposition. Ammonia levels tend to be high in buildings where manure is not regularly and thoroughly removed. Examples include buildings with litter, solid floors, or scrapers where manure is spread over the floor. Heated floors can increase ammonia release. Furthermore, when
pH levels are higher than 8.0, ammonia is more susceptible to being released. Ammonia is very soluble in water, therefore liquid manure systems tend to release less ammonia. Building ventilation also affects ammonia levels in the air. Concentrations in ventilated hog buildings have been measured as high as 35 ppm (slightly irritating to the eyes and nose) and in unventilated buildings as high 176 ppm, which can produce extreme discomfort.

**Carbon Dioxide**

Death of animals in closed confinement buildings following a ventilation-equipment failure (such as a power failure) is due in part to excessive carbon dioxide. Carbon dioxide (CO$_2$) is released by unvented heaters, through livestock respiration and manure decomposition. In fact, most of the gas in bubbles coming from stored manure or lagoons is CO$_2$. Vigorous agitation of stored manure can also release a large amount of carbon dioxide in a short time period.

**Carbon Monoxide**

Carbon monoxide (CO) can cause workers to develop headaches and experience chest pain. Pregnant women should be aware of the potential health hazard this gas poses to a developing fetus. Carbon monoxide is rare in confinement buildings, but can accumulate in areas with poor ventilation such as swine farrowing rooms and nursery buildings. Evidence of carbon monoxide overexposure among livestock may first appear as aborted litters and stillbirth. The main sources of CO are heaters (LP-fired, radiant brooder, or space).

**Hydrogen Sulfide**

Hydrogen Sulfide (H$_2$S) is the most toxic gas generated from the storage liquid manure storage. Exposure to 200 ppm for an hour can cause headaches and dizziness; 500 ppm for 30 minutes can cause severe headaches, nausea, excitement, or insomnia. High concentrations of 800 to 1,000 ppm can cause immediate unconsciousness and death through respiratory paralysis unless the victim is moved to fresh air and artificial respiration is immediately applied. Be aware—even the characteristic rotten-egg smell of hydrogen sulfide does not give adequate warning. The sense of smell is rapidly fatigued by the gas and high concentrations do
not give a proportionately higher odor intensity. Also note that dangerous concentrations can be released by agitation of stored liquid manure. Concentrations reaching 200 to 300 ppm have been reported in buildings a few minutes after starting to pump waste from a storage pit and can be as high as 800 ppm during vigorous agitation.

**METHANE**

Methane (CH$_4$) is a product of manure decomposition under strict anaerobic conditions, such as those found in an anaerobic or biogas digester. It is insoluble in water, lighter than air, and thus will accumulate in stagnant air corners in the top of enclosed pits or buildings. Methane is not toxic, but at high concentrations may cause an asphyxiating environment. Methane concentrations in confinement housing is normally well below the levels that may be explosive (Table 7-1). However, explosions attributed to methane have occurred around manure storage pits.

**FIRST AID FOR VICTIMS OF MANURE-GAS ASPHYXIATION**

1. Do not attempt to rescue a victim from a hazardous gas situation unless you are protected with a supplied air-breathing apparatus.

2. Have someone telephone for an emergency medical (rescue) squad, informing them there is a “victim of toxic gas asphyxiation.”

3. If the victim is free from the immediate area of danger and there is no personal threat to life, check for breathing (with the victim on his/her back). If there is no breathing, give four quick breaths and check for a pulse.

   - If there is a pulse, continue mouth-to-mouth breathing every 5 seconds (12 per minute).
   - If there is no pulse, start CPR (cardio-pulmonary resuscitation) immediately.

Training courses for rescue breathing and CPR are available through local Red Cross and Cooperative Extension Service centers. These courses provide the training and practice necessary to perform CPR.
Health problems associated with poor air quality include coughing, phlegm production, wheezing, chest tightness, headaches, shortness of breath, eye irritation, sneezing, runny nose, and nasal congestion. Problems are usually greater the more time a worker spends in the presence of the contaminant and the greater the concentrations of airborne contaminants. In addition, some people are more susceptible than others.

Health problems may be chronic (lasting a long time) or acute (severe but short term). Since chronic and acute problems can be mistaken for other health problems, such as the flu or allergies, the work environment is often overlooked as a cause of the symptoms and precautions are therefore not taken. Table 7-2 lists some symptoms swine facility workers in Iowa have experienced as the result of poor air quality in the swine houses.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Prevalence (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cough</td>
<td>67</td>
</tr>
<tr>
<td>Sputum or phlegm</td>
<td>56</td>
</tr>
<tr>
<td>Scratchy throat</td>
<td>54</td>
</tr>
<tr>
<td>Runny nose</td>
<td>45</td>
</tr>
<tr>
<td>Burning or watery eyes</td>
<td>39</td>
</tr>
<tr>
<td>Headaches</td>
<td>37</td>
</tr>
<tr>
<td>Chest tightness</td>
<td>36</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>30</td>
</tr>
<tr>
<td>Wheezing</td>
<td>27</td>
</tr>
</tbody>
</table>
You should consider safety when constructing, operating and managing animal waste management systems. The following major safety points should be considered when installing and operating manure equipment, structures, or systems:

1. Do not enter a manure pit unless following procedures for entering a confined space.

2. When agitating a manure storage structure, always have at least one additional person available to seek help if trouble occurs.

3. Properly designed and operated ventilation systems can reduce the concentration of gases within the building, thereby improving animal performance.

4. When possible, construct lids for manure pits and tanks. Keep these lids in place. If an open, ground-level tank or pit is necessary, build a fence around it and post with “Keep Out” and “Danger—Manure Storage” signs.

5. Get help before attempting to rescue livestock that have fallen into a manure storage structure.

6. Build railings along all walkways or piers of open manure storage structures.

7. Permanent ladders on the outside of above-ground tanks should have locked entry guards or the ladder should not be able to be reached from the ground.

8. Never leave a ladder standing against an above-ground tank.

9. Construct permanent ladders on the inside wall of all pits and tanks, even if covered. Use noncorrosive material to prevent deterioration of the ladder.

10. Fence in earthen storage ponds and lagoons, and erect signs: “Danger—Manure Storage.” Additional precautions include a minimum of one lifesaving station equipped with a reaching pole and a ring buoy on a line.
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11. All push-off platforms need a barrier strong enough to stop a slow-moving tractor.

12. If possible, remove animals from buildings before agitating manure stored in in-house pits. Otherwise:
   a. if the building is mechanically ventilated, turn fans on full capacity before starting agitation, or
   b. if the building is naturally ventilated, do not agitate unless there is a brisk breeze. Watch animals closely when beginning to agitate, and turn off the pump at the first sign of trouble.

13. If manure storage is outside the livestock building, use a water trap or other device to prevent gases from the storage structure from entering the building.

14. During agitation, if an animal becomes affected by toxic gases, do not try to rescue it. You might become a victim of toxic gases. Turn off the agitation pump, ventilate the building, and do not enter the building until gases have had a chance to escape.

15. Don’t smoke, weld, or use an open flame in confined, poorly ventilated areas where methane can accumulate. Electric motors, fixtures, and wiring near manure storage structures should be kept in good condition to prevent a spark from igniting the methane.

16. Keep all guards and safety shields on all mechanical equipment such as pumps, manure spreaders, and irrigation equipment.

**VEHICLE SAFETY**

Describe several safety precautions in regards to vehicle operation, heavy equipment, PTOs and hydraulic systems.

Only employees with a current, valid N.C. driver’s license should drive vehicles. In the case of specialized vehicles, only trained operators should operate the vehicles. The driver of the vehicle should inspect the vehicle prior to operating it.

1. All vehicles should be operated within the legal speed limit at all times or at a lower speed where conditions warrant.

2. Vehicles should not be used to transport unauthorized personnel.
3. The driver should be familiar with the capacity and required clearances for safe use of the vehicle.

4. Vehicle windshields and windows should be kept clear of obstructions.

5. Objects or persons being transported should be located so that they do not obstruct the driver’s view.

6. Always know the proper operating procedures for each piece of equipment used.

HEAVY EQUIPMENT VEHICLES

1. Make sure that the air brake system (if present) has reached operating pressure before driving the vehicle.

2. Make sure everyone is clear of the vehicle before starting. Slight steering movement can occur as the engine starts causing machine movement.

3. Stay clear of the engine when it is running. Work on the engine only when it is off.

4. Do not move the steering wheel until everyone is clear of the vehicle.

POWER TAKE-OFF (PTO)

1. Refer to the safety section of owner’s manual.

2. Stay clear of rear of vehicle during operation.

3. Do not wear loose fitting clothing, scarves, or jewelry that could get caught in the PTO.

4. Tie back long hair.

HYDRAULIC SYSTEMS
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1. Do not open pressurized lines. Hydraulic fluid can cause severe burns, eye injury, or skin irritation.

2. Search for leaks in the line using a piece of cardboard or wood, not your hands.

3. If anyone is injured by hydraulic fluid, administer first aid, then contact a physician.

4. Stay clear of leaky hydraulic lines.

**Electrical Safety**

All employees must lock-out/tag-out any piece of equipment they are working on where the unexpected energization, startup, or release of stored energy could occur. In case of electrocution, turn off power to the electrical source or use an insulated implement, such as a piece of wood, to separate the victim from the source. Do not attempt to pull a victim away from the electrical source with your bare hands.

**Responsibilities of the Site Supervisor**

The following should be the responsibility of the site supervisor:

1. Establish and supervise an accident prevention program and a training program that is designed to improve the skills and competency of all employees in the field of occupational safety and health.

2. Conduct preliminary investigations to determine the cause of any accident that results in injury. The results of this investigation should be documented for reference.

3. Establish and maintain a system for maintaining records of occupational injuries and illnesses.

4. Provide new employees with a safety orientation on the special hazards and precautions of any new job.

5. Conduct job briefings with employees before starting any job to acquaint them with unfamiliar procedures.

6. Issue necessary safety equipment and manuals.
7. Conduct periodic group safety meetings with all employees.

The Safety Program should include:

- procedures for reporting injuries;
- procedures for reporting unsafe conditions or practices;
- use and care of personal protective equipment;
- proper actions to be taken in the event of emergencies;
- identification of hazardous gases, chemicals, or materials; and
- instructions on safe use of hazardous gases, chemicals, or materials and emergency procedures following exposure.

**First Aid Training**

There should be a person available at all times with first aid training in:

- bleeding control and bandaging
- artificial respiration, including mouth-to-mouth resuscitation
- poisons
- shock, unconsciousness, stroke
- burns
- sunstroke, heat exhaustion
- frostbite, hypothermia
- strains, sprains, hernia
- fractures, dislocations
- bites, stings
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- transportation of the injured
- specific health hazards likely to be encountered by co-workers

There should be adequate, readily available first aid kits and supplies on site. Emergency telephone numbers must be posted by telephones.

**Eywash**

Suitable facilities for quick drenching or flushing of the eyes and body should be provided in areas where the eyes or body of any person may be exposed to injurious chemicals and materials.

The following are the responsibility of the **employer:**

1. The employer should furnish to each of his employees a workplace free from recognized hazards that may cause serious injury or death.

2. The employer should furnish and use safety devices and practices that are reasonably adequate to render the employee workplace safe. The employer should do everything reasonably necessary to protect the life and safety of employees.

3. No employer should require an employee to be in any workplace that is not safe.

The following are the responsibility of the **employee:**

1. Each employee should keep themselves informed of the contents of the appropriate sections of this manual and any other safety manual provided by the employer and apply it to their work.

2. Each employee should perform their duties so as to provide safety to themselves and other employees.
3. An employee should request instruction from the site supervisor if there is a question as to the safe performance of an assigned task.

4. Each employee should wear clothing that is suitable for the job performed.

5. Each employee is responsible to report to the site supervisor any unsafe condition, acts, or hazards.

6. Each employee should wear appropriate personal protective equipment.

**PERSONAL PROTECTIVE EQUIPMENT (PPE)**

Employees should use the appropriate personal protective equipment, or protective devices, provided for their work. Before starting work, these items should be inspected by the employee to ensure that they are in safe operating condition. These items include, but are not limited to:

- Hard hats should be worn when appropriate.
- Hearing protection should be used, as needed, to reduce noise levels when working around generators and heavy equipment.
- Eye protection should be worn when operating shop tools, and when working around chemicals.
- Safety belts/seat belts should be worn at all times in vehicles.
- Approved welding goggles or helmets and gloves should be worn while welding, cutting, or both. Fasten clothing around the neck, wrists, and ankles.

**LIFTING AND CARRYING**

Everyone should observe the following guidelines to avoid possible injury when lifting and carrying objects:

- Set your feet far enough apart to provide good balance and stability (approximately the width of your shoulders).
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- Get as close to the load as practical, bending your legs at the knees, and bending at the hips to keep your back as straight as possible.

- Straighten your legs to lift the object, and at the same time bring your back to a vertical position.

- When lifting an object with another person, be sure that both individuals lift at the same time and let the load down together.

- Do not carry loads above people. Do not hoist, lower, or move any person with a crane by allowing them to stand on the hook, or by any nonapproved method.

- Do not stand under a suspended load or boom unless the nature of the work requires it.

**PERSONAL HYGIENE**

Wastewater contains pathogens (disease-causing organisms). Hence, good personal hygiene is very important!

1. Keep your hands away from your nose, mouth, eyes, and ears to avoid ingestion of wastewater.

2. Nonpermeable gloves should be worn when handling any equipment covered with wastewater or residuals.

3. Special care (e.g., protective, waterproof dressing) should be taken to keep any area of broken skin covered to avoid possible infection. If a worker suffers an injury which results in an open wound or laceration, they should be given a tetanus booster.

4. Wash hands thoroughly with soap before smoking, eating, drinking, or after work.

5. Work clothing should be changed and washed daily.

6. If contact with wastewater does occur, wash the area thoroughly with water and soap. Sponge any cuts with an antiseptic solution.
and cover with a clean, dry gauze dressing and waterproof adhesive.

Each facility may want to consult a physician or the local health department to determine the need for immunizations for the employees working at the site. Adult tetanus and diphtheria should be given routinely every 10 years, or at shorter intervals when injury occurs.

A confined space is defined as a space that has limited means of entry and exit, has an adequate size and configuration for employee entry, and is not designed for continuous worker occupancy. The tanks designed for storage, transport, and application of wastes are classified as confined spaces and fall under the jurisdiction of the North Carolina Department of Labor, which is the agency that enforces the Occupational Safety and Health Act (OSHA). Under new OSHA regulations, there are certain confined spaces that require a permit for entry. A permit-required confined space is defined as a confined space that has one or more of the following characteristics:

1. it contains or has the potential to contain a hazardous atmosphere;
2. it contains a material that has the potential for engulfing an entrant;
3. it has an integral configuration such that an entrant could be trapped or asphyxiated by inwardly-converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
4. it contains any other recognized serious safety or health hazard.

If a facility has permit-required confined spaces, to be in compliance with the new OSHA regulations, a written confined space entry program must be developed and implemented. Enclosed facilities which are used to handle wastewater or wastewater solids, such as the tanks and/or tanker trucks, would fall under the permit-required confined space regulations. Do not enter a permit-required confined space without proper training, equipment, and support personnel. (The confined space regulations can be found in the Code of Federal Regulations 29 CFR 1910.147.)
Describe the safety actions that must be taken when working in a space that does not require a confined space permit.

When working in a space that does not require a confined space permit, the following safety actions must be taken:

1. Always assign a standby person to remain on the outside of the confined space. It is the standby person’s responsibility to be in constant contact (visually, verbally, or both) with the workers inside the confined space as long as anyone is in the space.

2. Wear ear protection, as needed. Noise within a confined space can be amplified because of the design and acoustic properties of the space.

3. Use only an air-supplying respirator, such as a self-contained breathing apparatus (SCBA) or a supplied-air respirator with an auxiliary escape-only SCBA in confined spaces where there is insufficient oxygen.

It is important to be fire conscious in the outdoor environment. Employees should be knowledgeable of the fire conditions at the site and operate accordingly. Poor site maintenance, worn or defective electrical systems, and welding and cutting may contribute to dangerous situations. The following precautions should be observed:

1. Do not smoke near equipment or fuel trailers. No open flame should be allowed near wastewater storage tanks. Combustible gases can accumulate and when vented to the surrounding area, may become explosive.

2. Do not tamper with or remove fire-fighting equipment from designated locations for purposes other than fire-fighting or rescue operations. Access to fire equipment should not be hindered. If fire extinguishers are used, they should be promptly recharged. Inspect fire extinguishers monthly to be sure they are in good operating condition.
Emergency action plans are required to meet current animal waste management regulations. Using resource lists in Appendix A, you should develop an emergency action plan for your waste handling system. This plan will be implemented in the event that wastes from your operation are leaking, overflowing, or running off the site. You should NOT wait until wastes reach surface waters or leave your property to consider that you have a problem. You should make every effort to ensure that this does not happen. This plan should be available to all employees at the facility, as accidents, leaks, and breaks could happen at any time. Your plan should follow this format: (1) stop the release of wastes; (2) assess the extent of the spill and note any obvious damages; (3) contact the appropriate agencies; and (4) implement procedures to rectify the damage and repair the waste management system.

1. **Stop the release of wastes.** Depending on the situation, this may or may not be possible. Suggested responses to several problems are listed below:

   a. *Lagoon or slurry basin overflow*—possible solutions are:

      - add soil to berm to increase elevation of dam
      - pump wastes to fields at an acceptable rate
      - stop all additional flow to the structure (waterers, flushing system, etc.)
      - call a pumping contractor
      - make sure no surface water is entering storage structure

      *Note: These activities should be started when your lagoon level has exceeded the temporary storage level (see Chapter 2).*
b. Runoff from waste application field—actions include:
   - immediately stop waste application
   - create a temporary diversion or berm to contain the waste on the field
   - incorporate waste to reduce further runoff
   - evaluate and eliminate the reason(s) that caused the runoff
   - evaluate the application rates for the fields where runoff occurred

c. Leakage from the waste distribution system:
   - pipes and sprinklers—actions include:
     - stop recycle (flushing system) pump
     - stop irrigation pump
     - close valves to eliminate further discharge
     - separate pipes to create an air gap and stop flow
     - repair all leaks prior to restarting pumps
   - flush system, houses, solids separators—actions include:
     - stop recycle (flushing system) pump
     - stop irrigation pump
     - make sure no siphon effect has been created
     - separate pipes to create an air gap and stop flow
     - repair all leaks prior to restarting pumps
d. *Leakage from base or sidewall of lagoon or earthen storage structure.* Often these are seepage rather than flowing leaks — possible action:

- dig a small well or ditch to catch all seepage, put in a submersible pump, and pump back into lagoon
- if holes are caused by burrowing animals, trap or remove animals and fill holes and compact with a clay type soil
- other holes may be likewise temporarily plugged with clay soil

*Note: Problems with lagoons and earthen storage structures require the consultation of an individual experienced in the design and installation of lagoons for permanent repair measures.*

2. **Assess the extent of the spill** and note any obvious damages.

   a. *Did the waste reach any surface waters?*

   b. *Approximately how much was released and for what duration?*

   c. *Any damage noted, such as employee injury, fish kills, or property damage?*

   d. *Did the spill leave the property?*

   e. *Does the spill have the potential to reach surface waters?*

   f. *Could a future rain event cause the spill to reach surface waters?*

   g. *Are potable water wells in danger (either on or off the property)?*
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3. **Contact appropriate agencies** (agency listing in Appendix A).
   a. *During normal business hours, call your DWQ regional office; after hours, call this emergency number: 1-800-858-0368.*
      Your phone call should include: your name, facility, telephone number, the details of the incident from item 2 above, the exact location of the facility, and the location or direction of movement of the spill, weather and wind conditions, what corrective measures have been undertaken, and the seriousness of the situation.
   b. *If spill leaves property or enters surface waters, call local EMS (see Appendix A).*
   c. *Instruct EMS to contact local Health Department.*
   d. *Contact CES, local SWCD office, and local NRCS office for advice/technical assistance.*
   e. *If none of the above works, call 911 or the Sheriff’s Department and explain your problem to them. Ask them to contact the agencies as listed above.*

4. **Implement procedures** as advised by DWQ and technical assistance agencies to rectify the damage, repair the system, and reassess the waste management plan to keep problems with release of wastes from happening again.

The emergency action plan must include provisions for emergency spreading or transfer of waste from all waste storage structures in the system. This may include emergency pumping or spreading (to prevent overtopping of a storage structure) during periods when the soil or crop conditions are not conducive to normal spreading or application. DWQ must be contacted for guidance to land apply waste in this instance. You should consider which fields are best able to handle the waste without further environmental damage. Application rates, methods, and minimum buffer distances must all be addressed. If transferring waste to another location for application, consider the limitations that may be involved with the transfer of waste to that site and application considerations at that location.
The emergency action plan should be available and understood by all employees at the facility. The main points of the plan (order of action) along with the relevant phone numbers should be posted by all telephones at the site. A copy should also be available in remote locations or vehicles if the land application sites are not close by the facility office. It is the responsibility of the owner or manager of the facility that all employees understand what circumstances constitute an imminent danger to the environment or health and safety of workers and neighbors. The employees should be able to respond to such emergencies and notify the appropriate agencies of conditions at the facility.

1. List some gases that may cause concern at an animal operation, and some methods to minimize risk and exposure to these gases. ........................................................................................................................................ see page 7-1

2. Name some system components at an animal operation where safety checks are necessary. ........................................... see page 7-5 to 7-8

3. What is a confined space? ........................................... see page 7-13

4. Whose responsibility is it to develop an emergency action plan? ...................................................................................... see page 7-15

5. List the major components of an emergency action plan. ...................................................................................... see page 7-15

Describe where the emergency action plan should be located and who should be aware of it.