Common Safety Practices for On-Farm Anaerobic Digestion Systems

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1.0 INTRODUCTION

Several safety hazards exist when converting manure and organic residuals (non-farm feedstock) into energy using anaerobic digestion (AD) technology. These hazards can cause serious bodily harm and in some circumstances, can be fatal. Common hazards associated with AD systems include drowning, electric shock, and noise exposure. However, biogas and its constituents, many of which are colorless and odorless, can unknowingly expose operators and visitors to hazards such as asphyxiation and burns due the flammable nature of methane. Workers must take proper precautions when handling and storing organic material and managing the production of electricity and combustible gases.

Figure 1: Safety signage on AD feed system

The purpose of this document is to identify the major hazards associated with an AD facility and outline basic practices that will help maintain a safe and successful working environment. The intended audience for this guide is owners and operators, and the guide is not intended to replace safety training or instruction, but rather enhance it.

2.0 SAFETY HAZARDS FOR ANAEROBIC DIGESTION

The following sections identify major hazards that can exist with an AD facility. These include:

- General safety precautions
- Hazards associated with biogas
- Confined space entry
- Electrical system hazards

Figure 1 shows a feed hopper for an anaerobic digester with a dozen warning signs, including fall, entanglement, and explosion potential.

2.1 GENERAL SAFETY PRECAUTIONS

The following sections describe general safety concerns associated with AD facilities.

2.1.1 Drowning

Liquid tanks and ponds for storage pose a drowning threat. Whenever a drowning potential exists, ring buoys, ropes, or ladders should be readily available for rescue purposes (Occupational Safety and Health Administration [OSHA], 2002). The drowning risk is highest when employees are servicing equipment located in digester or storage tanks. Accidental drowning can occur when people unfamiliar with the farm and manure handling system mistakenly enter storage structures. Slipping on a synthetic liner or walking on crusted manure storage are examples of situations that can lead to accidental drowning. OSHA suggests posting signs similar to the one shown in Figure 2 and erecting fences around manure storage structures to reduce the potential of an individual or animal unknowingly entering one.

Figure 2: Manure storage warning sign in English and Spanish

If an individual is drowning, the first step should be to call 911, followed by a rescue attempt using a life preserver, rope, or ladder. The presence of biogas—an asphyxiant that can cause a person to pass out—can increase the potential of manure storage drowning. (Biogas hazards are discussed in greater detail in Section 2.3.) Individuals attempting to rescue a drowning individual should never enter a manure storage structure because they could also be overcome by the poor air quality.

2.1.2 Fall protection

Serious injuries can result from falls of any distance. When possible, employees should perform maintenance work from the ground. At most AD facilities, however, multiple elevated locations are present. For example, equipment on the top of aboveground AD tanks are 10 to 25 feet off the ground. According to the OSHA general industry standard any "time a worker is at a height of four feet or more, the worker is at risk and needs to be protected" (OSHA, 2008A). Fall protection, such as guardrails, a safety harness (also discussed in Section 2.2.4), and self-retracting lifelines, should be used when an employee is above the 4-foot threshold (API, 2006). The enclosed fixed ladder and guardrail system on the feedstock storage tank shown in Figure 3 complies with OSHA fall protection standards.

Another common example of a fall risk is shown in Figure 4, where a ladder is leaned against a feedstock storage tank. The two concerns with the situation presented in Figure 4 are: (1) the tank height is approximately 10 feet and (2) there are no securing devices or slip resistant feet on the ladder, nor is there a rope to secure the top. When ladders are used to access elevated equipment, they should be secured and supervised at all times. Once the ladder is no longer needed, it should be removed.

Figure 3: Permanent ladder and guardrail on feedstock storage tank

2.1.3 Burns

Throughout an AD facility, pipes containing hot fluids or exhaust gas can pose potential burn hazards. Other potential sources of burns are heat exchangers, boilers, pumps, or engine generators, where temperatures can exceed 160^{o}F. Simply rubbing up against a heat exchanger or accidently placing a hand on a hot pipe can result in serious burns. All employees and visitors to the AD facility should be cautioned not to touch any equipment or pipelines.

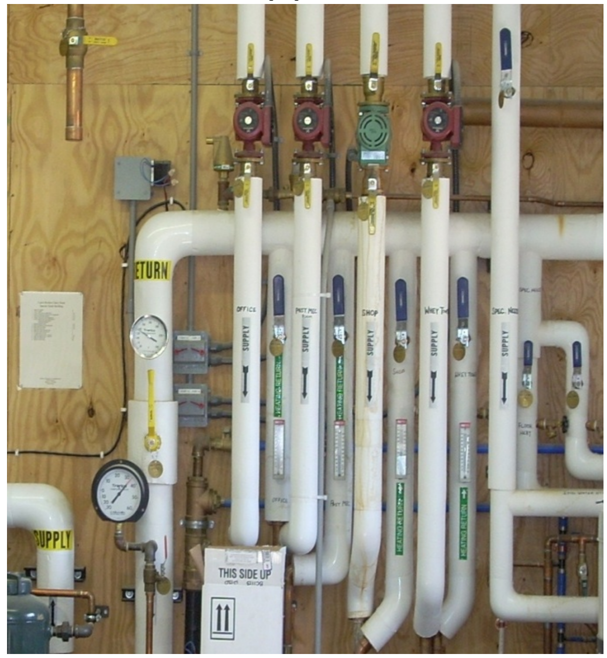
When possible, hot surfaces should be identified as burn hazards, and all pipes should be clearly labeled to indicate the contents, flow direction, temperature, and pressure. Insulation should be used to encase the pipe and reduce the potential for accidental burns. Figures 5 and 6 provide examples of pipeline insulation and labeling.

Figure 4: Ladder leaning on feedstock storage tank

2.1.4 Entanglement hazard

Pumps, augers, impeller mixers, chains, drive shafts, and other machinery pose entanglement hazards due to pinch points and other moving parts. In most AD systems, the primary exposure to entanglement is the unguarded driveshaft of a pump. To reduce the entanglement risk, all equipment safety guards should be in place and individuals should tie back long hair and avoid wearing loose-fitting clothing and jewelry.

Figure 5: Insulated and labeled hot water pipes



2.1.5 Feedstock and digestate spills

Feedstock (any organic material entering the digester) and digestate (any material exiting the digester) should be carefully transferred and contained. In the event of a major feedstock or digestate spill, workers should exercise caution when containing the material. The first step should be to control the source causing the spill. Once this is achieved, workers should contain the spill by constructing temporary containment structures around the affected area. Excavation equipment such as bulldozers and backhoes should be readily available for this purpose. Isolating the spill reduces potential damage to nearby buildings and contamination of surface waters and sensitive areas. After containing the spill, the facility should notify the proper authorities (as defined by state-specific permits), to comply with all applicable local, state, and federal regulations. For non-farm feedstocks, such as food waste, the spill-reporting agency should be clearly identified on all records related to the material, including material safety data sheets (MSDS) and manifest logs indicating the date, quantity, and material (feedstock) brought onto the farm. The final step in spill response is site cleanup and restoration.

Figure 6: Biogas pipeline indicating temperature and flow direction

2.1.6 Mechanical failures

In the event of a mechanical failure, workers should reference the vendor manuals to troubleshoot the issue. Vendor manuals for mechanical machinery should be organized and included in the emergency action plan, which is discussed in Section 3.1. Only trained staff should be permitted to repair digester equipment. Operators should use lockout/tagout procedures (see Section 2.1.7) during all mechanical equipment repairs.

To avoid mechanical failures, the system operator, with support from the technology provider, should develop a preventative maintenance manual for the site.

2.1.7 Lockout/Tagout

According to OSHA standard 29 CFR 1910.147, lockout/tagout refers to the specific "practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities" (OSHA, 2007A). Simply stated, before an employee services a piece of electrical equipment, the power supply should be turned off and the employee should place a padlock on the power supply. The padlock serves to prevent someone else from accidently re-energizing the equipment being serviced. The lock should have a tag on it identifying the individual who locked out the equipment. In Figure 7, one of the four electrical breakers shown is turned off (disengaged) and locked out. Once a piece of equipment has been locked out, the only individual with the authority to unlock that piece of equipment is the person who initially locked it out.

Figure 7: Electrical panel turned off and locked out

Employees should follow this practice every time they service any electrical or electrically powered equipment. OSHA estimates that compliance with lockout/tagout procedures prevents an estimated 120 fatalities and 50,000 injuries each year in the United States (2007A).

2.1.8 Ignition sources

Biogas generated during anaerobic digestion is flammable. Over the past couple of years, several AD systems have been damaged or destroyed by fires fueled with biogas. While no specific setbacks or standards have been established for biogas, facilities should observe standards for similar systems. The National Fire Protection Association (NFPA) has established a range of setback distances for liquid propane (LP) fuel based on storage capacity (2009). For LP gas, the setback ranges from 10 feet for small storage devices (<500 gal water capacity) to 100 feet for large storage systems (>70,000 gal water capacity).

Smoking and open flames should be prohibited in the general vicinity of the digester and a setback distance of 25 to 50 feet is suggested for all possible ignition sources to reduce the potential for fire or explosion. Ignition sources can include (but are not limited to) light switches, electric motors, pilot flames, and cell phones. Facilities should designate smoking areas at least 50 feet from the digester system to ensure that visitors and employees do not inadvertently create an ignition source. Signs, like the one shown in Figure 8, should also be used to warn all individuals of the explosion or fire risk associated with AD systems.

Figure 8: Explosion potential sign

The National Electric Code (NEC, 2005) dictates that electrical wiring near combustible gas must conform with the Class 1, Division 1 hazardous location standard. Biogas is combustible, so the hazardous location standard should be applied to AD systems' electrical wiring.

For repairs requiring open flames or electric spark, ventilation should be provided such that methane levels are maintained below a safe level, as discussed in Section 2.3.3.

Figure 9: Gen set enclosure with hearing protection warning sign

2.1.9 Noise levels

Exposure to high levels of noise can result in discomfort or short-term hearing loss. In extreme cases, or if the noise exposure occurs over a long period of time, permanent hearing loss can occur. The main source of high noise levels is the engine generator set (gen set). Actual decibel (dB) levels produced at an AD facility will differ due to varying acoustical settings, but a gen set can produce between 100 – 140 dB (Fenton, 2011). The facility is required to supply noise protection devices, such as earplugs, to employees and visitors who are exposed to high noise levels (OSHA, 2008B) (See Table 1). Handheld decibel meters are widely available and provide an inexpensive method to quickly determine the noise level. Also, OSHA encourages posting signs indicating "hearing protection is required in this area." (See Figure 9).

Table 1: Safe maximum allowable decibel level (OSHA, 2008B)

Duration per day (hours)	Sound level (dB) (as measured with a sound level meter set on slow response
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25	115

2.2 CONFINED SPACE ENTRY

Constituents of biogas, including carbon dioxide, methane, and hydrogen sulfide, present the potential for both asphyxiation and fire or explosion in confined spaces. It is important to remember that even a few gallons of manure or other organic material in a tank or confined space can pose a serious health risk under the right conditions. A recent example of confined space entry fatality occurred in July of 2010 when two farm employees died while cleaning a storage tank similar to the one shown in Figure 4 (Michigan Department of Energy, Labor and Economic Growth [MEDLEG]). Signs should be used to alert employees and visitors when confined space entry risks exist. Figure 10 shows an example of a standard confined space warning sign. The following background information and guidelines are intended to promote a safe working environment when confined space is involved.

Figure 10: Basic confined space warning sign

2.2.1 Definition

"Confined space" is defined by OSHA as "having a limited or restricted means of entry or exit; large enough to bodily enter and perform tasks; and lastly, not designed for continuous occupancy." Currently, state-by-state standards vary for permit-required confined spaces training for agriculture; however, confined spaces are widely recognized as a common hazard. Confined spaces include, but are not limited to, tanks, pits, silos, underground vaults, storage bins, and manholes (MDELEG, 2010).

2.2.2 Confined space training, certification, and rescue plan

Employees associated with AD systems or who manage organic residuals **MUST** be trained in confined space entry to maintain a safe working environment (Gould, 2010). Several cases have resulted in fatalities due to a lack of understanding of the hazards associated with confined spaces. As discussed earlier, two farm employees died when they were overcome by a lack of oxygen while cleaning a feedstock storage tank (MDELEG, 2010). The employees were power washing a tank that contained only 6 to 8 inches of molasses residue, which had sat unused for five to six months. By conducting basic employee education and strictly adhering to OSHA confined space entry guidelines, facilities can provide a safe working environment for farm employees.

Figure 11: Handheld multi-gas detectors

Images from Google images

Currently, OSHA does not require farms to offer specific training for confined space entry; however, it is the employer's responsibility to educate employees in order to maintain a safe working environment. When entering a confined space, the "buddy system" should be used, in which any person entering a confined space is monitored from a safe distance by a second person. The employee entering the confined space must wear a harness attached to a retraction device that the second employee can activate to pull the individual to safety in an emergency.

The facility should develop a rescue plan for emergency confined space entry situations. This plan should describe the use of the safety equipment in emergency situations, the actions to be taken, and the personnel responsible for each action. The plan may also include training and certification information.

2.2.3 Inspect atmosphere prior to entry

Before entering a confined space, a worker must test the atmosphere inside the space, as required by OSHA general industry standard 1910.146 (1998). The person can perform this testing using a handheld multi-gas detector capable of detecting oxygen, carbon monoxide, hydrogen sulfide, and lower explosive limits (LEL) levels. Several models of multi-gas detectors are shown in Figure 11. When testing the atmosphere within a confined space, the employee should remain outside in a safe location. Many multi-gas detectors are equipped with an extension hose for this purpose.

In compliance with standards (OSHA, 1998), the employee should test for the following:

1. Oxygen level: above 19.5 percent by volume air
2. Methane: below 5 percent by volume of air
3. Hydrogen sulfide level: below 20 parts per million (ppm)

If any of the above conditions are not met, the atmosphere is deemed hazardous and should not be entered by any personnel until forced ventilation has eliminated the hazardous conditions. During entry, continuous ventilation with an explosion-proof blower will ensure that fresh air is displacing any hazardous air that may be trapped in the confined space. Workers must maintain and calibrate this equipment according to the manufacturer's recommendation in order to effectively monitor atmospheric conditions.

Figure 12: Safety harnesses, ropes, and a chain fall at an AD facility

2.2.4 Safety equipment

When entering a confined space, an employee should wear a safety harness attached to a winch or pulley outside of the pit. Examples of safety harnesses and a winch are shown in Figure 12. This safety precaution, allows a coworker to assist a trapped employee without having to enter the space in the event of an emergency.

A self-contained breathing apparatus (SCBA) should be used only in emergency situations.

Figure 13 shows a basic backpack-style SCBA with fitted facemask. Any employee using a SCBA must be properly trained and fitted for using the equipment. For an individual to become certified in confined space entry, they should consult the State approved OSHA administration.

Figure 13: Self-contained breathing apparatus

Image from http://www.envisupply.com/

2.3 HAZARDS ASSOCIATED WITH BIOGAS

AD biogas is composed of three main constituents: methane, hydrogen sulfide, and carbon dioxide. Each of these gases can be dangerous under certain circumstances. Common hazards associated with biogas include asphyxiation and fire or explosion potential.

Overall, it is always a good idea to test the atmosphere when biogas may be present as well as maintain proper ventilation. Workers can use a handheld multi-gas detector, similar to one of those shown in Figure 11, to determine if hazardous levels of biogas are present. Low-cost detectors will simply identify dangerous level of biogas, while higher end detectors can report specific concentrations of the primary biogas components.

2.3.1 Asphyxiants

Gases that prevent the uptake of oxygen into human cells are referred to as asphyxiants. There are two categories of asphyxiants: simple and chemical. A simple asphyxiant displaces oxygen, and chemical asphyxiants “reduce the body’s ability to absorb, transport, or utilize inhaled oxygen. Asphyxiants are often active at very low concentrations (a few ppm)” (Lawrence Berkeley National Laboratory, 2008). Asphyxiant gases are present wherever there is storage of an organic material; therefore, manure pits or any other areas for organic material storage become potentially dangerous. Following are the various asphyxiants that are typical constituents of biogas.

- **Simple asphyxiants** – carbon dioxide and methane
- **Chemical asphyxiants** – ammonia and hydrogen sulfide

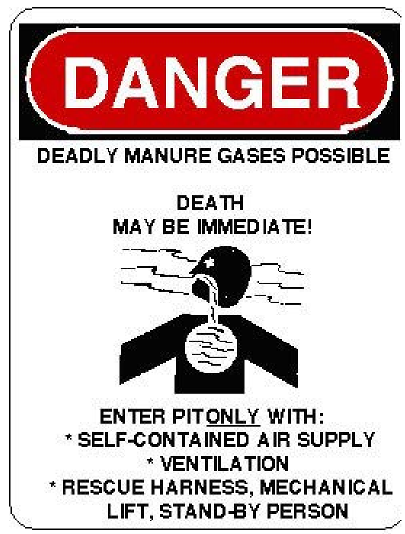
2.3.2 Immediately dangerous to life and health

Within confined spaces and other covered areas, the potential exists for atmospheric concentrations to develop that become immediately dangerous to life and health (IDLH). An IDLH condition can be defined as an atmospheric concentration of any toxic, corrosive, or asphyxiant substance (simple or chemical) that “poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual’s ability to escape from a dangerous atmosphere” (OSHA, 2008C). Following are the main IDLH concerns when handling the production of biogas (Center for Disease Control and Prevention, 1995).

- **Oxygen deficiency** – less than 19.5 percent by volume air
- **Hydrogen sulfide** – more than 100 ppm
- **Ammonia** – more than 300 ppm
- **Carbon dioxide** – more than 40,000 ppm

Signs similar to the one shown in Figure 14 should be used to alert employees and visitors of the potential for IDLH conditions. Areas prone to these conditions include structures housing the gen set or boiler, below grade pump chambers, and biogas storage devices.

Figure 14: Sign indicating IDLH potential



A simple and convenient way to ensure the safety of an area’s atmosphere is by installing a wall-mounted sensor that can detect hazardous gases (e.g., methane, LEL, hydrogen sulfide, carbon monoxide). In the event that a hazardous gas sensor is triggered, the emergency action plan (see Section 3) should be implemented.

2.3.3 Explosion potential

Methane, the main component of biogas, is flammable when it mixes with air. Upper and lower explosive limits (LEL) are established to provide an identifiable range of concentrations that will produce a flash fire when an ignition source is presented. The LEL is often referred to as a flammable limit. For methane, the lower and upper explosive limit is 5 percent and 15 percent by volume of air, respectively (Linde Gas LLC, 1995).

Figure 15: Safety signs posted at AD facility

2.4 ELECTRICAL SYSTEM HAZARDS

The generation of large quantities of electricity at an AD facility creates electrical hazards, most of which can be found near the gen set, transformer, and electrical panels. The only personnel with the authority to service and repair electrical systems are licensed electricians. In addition, the facility should post signs identifying general electrical hazards near the electrical generation system (see Figure 15 for an example of basic signage).

2.4.1 High voltage

Any electrical source above 600 volts is considered high voltage (NEC, 2005). Typically, transmission lines from the transformer are the source of the highest voltage on a farm. A transformer is a piece of machinery used to increase the voltage, allowing for more efficient transport of the electricity. When dealing with such high voltage, the main hazard is contact with exposed leads, which could be fatal. Figure 16 shows exposed lead transformers commonly used on utility poles. Ground-mounted transformers used on farms and at AD facilities are typically enclosed like the one shown in Figure 17. Enclosed transformers should remain sealed and locked at all times, and only a licensed electrician should perform transformer maintenance.

Figure 16: Standard electrical transformer with exposed leads

Figure 17: Enclosed electrical transformer

2.4.2 Low voltage

All electrical sources less than 600 volts are considered low voltage (NEC, 2005). Typically, switches, controllers, fuses, breakers, wall outlets, and electrical panels are considered low-voltage devices. One major hazard associated with electrical panels is arcing, which occurs when electricity from an energized source jumps a gap of air and discharges into an adjacent conductive surface, typically metal. If an individual happens to be in the pathway of the arc, they can be seriously burned or killed. Cover plates are used to contain arcing by shielding the employee from any potential harm. Therefore, the facility should ensure that the proper cover plates are intact and correctly in place on the panel or outlet.

2.4.3 Electrical fires

In the event of an electrical fire, the person fighting the fire should use an ABC classified multi-purpose fire extinguisher rather than a water-based fire extinguisher, which could result in electrocution. If possible, the electricity should be shut off to the facility before fighting the fire. The facility should train operators to identify the difference between electrical fires and ordinary combustible fires (Wallenwine, 2011).

3.0 MAINTAINING A SAFE WORKING ENVIRONMENT

AD facilities can provide a safe working environment, as long as proper safety measures are taken. The following sections present recommended steps for maintaining a safe working environment at AD facilities, adapted from the self-assessment guide prepared by Nellie Brown (2007), titled "Conducting a Safety Walk-through on a Farm: Hazards of the Manure Handling System, Anaerobic Digester, and Biogas Handling System" and the emergency action plan requirements of the National Pollution Discharge Elimination System (NPDES) program.

3.1 EMERGENCY ACTION PLAN

In most states, AD facilities are required to have emergency action plans (EAP) as part of their NPDES permits. A major objective of an EAP is to develop response protocols to specific emergencies so that if an accident occurs the facility will conduct the appropriate actions in the correct sequence. As a general recommendation, each situation should be broken down into the following components.

1. Assess the extent of damage in the following order:
    a. Human health
    b. Environmental health
    c. Mechanical integrity

2. Correct the problem immediately if possible.

3. Contact the appropriate agencies and personnel to resolve the problem.

The contents of an EAP should be well organized in a binder or an electronic file and distributed to all employees so that they are informed of the proper safety protocols. The facility should provide local emergency departments with a copy of the EAP and invite them for a tour of the operation so they can become familiar with the facility. Also, the facility should post a copy in a highly visible area where visitors enter the facility.

To maintain an effective EAP, the facility should perform an annual review of the document to keep it up to date. Conducting annual training sessions will ensure that employees have a basic understanding of the EAP. The following sections present the recommended content to be included in an EAP.

3.1.1 Directions to AD facility

Often, the AD facility is not clearly visible from the main road, especially if it is located in an agricultural setting. Therefore, detailed driving directions from the closest major road, intersection, or town to the physical location of the AD facility should be included in the EAP.

3.1.2 Contact information

The EAP should provide a list of emergency and non-emergency contacts, including the job title and cell phone number of each person. Recommended contacts are:

- Farm or AD owner
- AD operators
- Emergency and nonemergency responders
    - Fire department
    - Poison control
    - Law enforcement
    - Hospital
- Electric and gas utilities
- Contractors
    - Electrical
    - Excavation
    - Mechanical
- State health and safety officials

Contact information should identify the appropriate after-hours emergency contact information as well. The contact list should be posted in multiple locations throughout the AD facility and farm so that in the event of an emergency, there is quick and easy access to this information. It is important that the contact list be updated routinely to make sure all information is current.

In many rural locations, calling 911 may not be the best method for reaching emergency responders. On an annual basis, the AD operator or owner should host a site tour with the local fire, ambulance, and sheriff departments. The purpose of this tour would be to familiarize emergency responders with the site and system, as well as identify the most direct contact method in the event of an emergency.

3.1.3 Site map

The EAP should include a detailed site map that identifies and labels relevant structures and major equipment (e.g., flare, gen set, boiler) at the AD facility, as well as the location of emergency equipment. It should also clearly identify the locations of biogas supply shutoff valves and the primary electrical disconnect and control panel.

3.1.4 State and local health and safety requirements

The EAP should include the federal and state health and safety regulations for the facility, as well as all OSHA documents, guidelines, and certifications, including confined space entry training documents. In addition, MSDS for non-farm feedstock and any chemical or biological additives should be included in the EAP and posted at the facility so that employees can have quick access to the information.

3.1.5 Equipment vendor manuals

The EAP should include the vendor manuals for all equipment at the AD facility. These materials should be well organized so that in the case of a mechanical failure, an operator can locate and reference a specific vendor manual quickly and easily.

3.2 SAFETY AND EMERGENCY EQUIPMENT

The following sections list recommended supplies and equipment an AD facility should have available for normal daily operation or in the event of an emergency. The list is divided into supplies and equipment to be maintained on site, so employees can access it within minutes, and equipment that should be locally available and could be delivered to the site within a few hours. A logbook of equipment inspections and expiration dates and the equipment manuals should be located with the safety equipment.

3.2.1 Anaerobic digester facility (onsite)

- Personal protective equipment
    - Gloves
    - Safety glasses

  - Hearing protection
  - SCBA (provided employees are properly trained and fitted for using the equipment).

- First aid kit
- Fire extinguishers (ABC)
- Explosion-proof instruments (e.g., flashlight, ventilation blower, hand tools)
- Rigging equipment for rescue of a person
  - Hoist, winch, or pulley
  - Safety harness
- Multi-gas detector with extension hose
- Ring buoy
- Shovel

3.2.2 Locally (able to be onsite within a few hours)

- Excavation equipment (e.g., bull dozer, backhoe, excavator)
- SCBA and trained individual

3.2.3 Baseline environmental conditions

During startup and for the first 6 to 12 months of use, operators should collect operational parameters and air quality measurements around the AD facility on a weekly basis to establish baseline/normal operating conditions. Basic operational parameters should include pressure and temperature readings on pipelines where gauges are installed. Using a handheld multi-gas meter, employees should check the air quality inside all structures or rooms, along with the conditions in below-grade pump chambers, near the base of digester tanks, and along biogas pipelines. At a minimum, the concentration levels of hydrogen sulfide, carbon monoxide, and methane should be measured and recorded. By establishing baseline operating conditions, the AD operator has a point of reference for troubleshooting operational problems and determining when hazardous conditions are developing or already exist.

3.3 ELECTRICAL

The following section provides common practices to help maintain safety by reducing the potential for electrical hazards that may occur at an AD facility.

3.3.1 Daily inspections

The AD facility should instruct operators to perform daily inspections of the electrical system. This inspection should include, but not be limited to, the following:

- Conduit connections to panels
- Panel cover integrity
- Conduit integrity
- Exposed and damaged wires
- Corrosion of wires
- Signs of electrical overheating

Figure 18: Corrosion on an electrical control panel

If there is any sign of the aforementioned problems, operators should contact the site manager or a licensed electrician to resolve the issue. Figure 18 shows a corroded electrical control panel that an operator should identify for repair during daily inspections. The operator should not attempt to fix the problem unless he or she is the appointed licensed electrician for the facility.

3.3.2 Switches, controllers, fuses, and breaker panels

Electrical panels should not be obstructed by any object that would impede the accessibility of the panel itself. For example, temporarily placing a 55-gallon drum below a circuit breaker or installing a pump below a control panel would impede accessibility. Moreover, electrical panels should always be visible so that emergency responders can locate them easily. This becomes imperative when an electrician unfamiliar with the facility needs to turn off the power quickly in an emergency situation.

All electrical panels should be well labeled and include an accurate, up-to-date copy of the wiring diagram (Wallenwine, 2011). Additional copies of the wiring diagram should be maintained off site and digitally in the event that a copy is lost, damaged, or destroyed. The facility should check the local electrical code to determine the clearance required around the electrical panel.

3.3.3 Roles of operators

An operator inspects and observes any defective electrical problems but does not perform any electrical maintenance. A licensed electrical engineer appointed by the AD facility is responsible for maintenance and repair of electrical problems.

3.3.4 Visitors on site

Unattended facilities associated with the AD system should be locked to limit risk to individuals unfamiliar with the surroundings and to ensure that the system continues to operate efficiently. Employees familiar with the AD system should escort visitors at all times. Visitors to an AD facility are not to operate any switches, controllers, or other electrical functions, including light switches.

3.4 PERSONAL PROTECTIVE EQUIPMENT

Personnel at an AD facility should be provided with proper-fitting personal protective equipment (PPE). The employer is responsible for communicating and educating the employees on the proper use of PPE (OSHA, 2007B). At a minimum, OSHA recommends protective gloves, splash-proof goggles, hearing protection, and steel toe shoes for employees associated with the digester system. For visitors to the facility, safety glasses and hearing protection should be available and worn while on site.

3.5 ACCIDENT PREVENTION SIGNS AND TAGS

Accident prevention signs and tags should be visible at all times when work is being performed where a hazard may be present and should be removed or covered promptly when the hazards no longer exist. Also, caution signs should be designed to be understood by non-English speakers. The EAP should include resources documenting where proper signs or tags can be obtained for potential facility hazards. A variety of OSHA-approved accident prevention signs are shown in Figure 19.

Figure 19: OSHA accident prevention signs

3.6 PERSONNEL TRAINING REQUIREMENTS

Annually, the facility should review the EAP with all employees associated with the AD system and new hires should go through safety and system operation training before being permitted to work at the AD facility. In addition, owners of systems should be aware of OSHA requirements and comply with employee training requirements.

4.0 CONCLUSION

Anaerobic digestion provides a real opportunity to address farm-related environmental concerns, generate renewable energy, and diversify farm products. It is important to realize, however, that AD systems pose unique challenges and safety risks not experienced on typical farms. These risks can be mitigated by practical measures, including educating employees about the risks associated with the system, implementing strict safety procedures, and having a detailed and up to date EAP that employees are familiar with. Ensuring a safe environment around the AD facility will protect employees and visitors while enhancing the overall performance of the digester.

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