

Poultry Depopulation Guide & Decision Tree



Introduction

Veterinarians are trained and responsible for decisions that impact care during an animal's life and for end-of-life decisions. Specifically, the three end-of-life categories include: euthanasia, slaughter and depopulation. For euthanasia and slaughter of poultry, methods which result in minimal pain and distress should be utilized to humanely end the life of individual animals¹. For depopulation of poultry, various end-of-life methods can be utilized during emergency situations that support welfare decisions for the flock. This guide explores decisions and methods of depopulation of poultry and expands upon some techniques that are only used during emergency depopulation events.

Depopulation is the **rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable**. It is required when urgent circumstances threaten animal populations with consideration given to human safety and/or the environment. Depopulation is not to be deployed under ordinary circumstances and should only be applied during times of emergency.

Choosing to use the best depopulation method must involve assessment of the reason for depopulation (ex: containment related to disease spread, natural disaster or other unprecedented emergency), evaluation of ethical considerations, assessment of human safety precautions, and regulatory expectations. This guidance document has been created for poultry company decision-makers, production teams, crews, transportation teams, Quality Assurance/Veterinary/Animal Welfare team members, and farmers to help support planning and decisions during possible emergency situations that require depopulation.

This guide is based on recommendations from the AVMA Guidelines for Depopulation (2019)² and practical knowledge and references from poultry scientists & industry experts for the depopulation of poultry. The goals of the guide are to (1) increase awareness about available emergency poultry depopulation methods, (2) provide details about how methods can be applied under various circumstances where commercial flocks are raised, and (3) suggest additional considerations (supplies, media response, security, etc.) that may need to be initiated for depopulation during emergencies. It is highly recommended that every farm has a depopulation plan(s) in place before an emergency or urgent situation occurs, which takes into account the various scenarios presented in these guidelines. These recommendations should be validated with your local regulatory authorities.

¹AVMA Humane Endings (<https://www.avma.org/resources-tools/animal-health-and-welfare/humane-endings>)

²AVMA Guidelines for Depopulation (2019) (<https://www.avma.org/sites/default/files/resources/AVMA-Guidelines-for-the-Depopulation-of-Animals.pdf>)

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Depopulation defined

The American Veterinary Medical Association (AVMA) has defined depopulation as the rapid and efficient destruction of a complete population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable.²

Ethical decisions during an emergency³

Depopulation involves making ethical decisions within the context of the emergency situation. The hard decisions that need to be made during the extraordinary situation should be based on sound ethical grounding and standards. Ethical reasoning cannot be suspended or ignored, even during an emergency scenario.

Specifically, for poultry depopulation, an ethical analysis should be conducted by decision-makers that considers the specific scenario, the stakeholders (internal and external), and the harms and the benefits when deciding which method to use. Examples of the harms and benefits to be considered include:

Harms Domains	Benefits Domains
Animal welfare	Human health
Personnel distress (emotional toll)	Animal health
Environmental harm	Socioeconomic impact
Reputational harm	Safety & efficacy

The depopulation method(s) considered must involve the balance of benefits (ex: broader goals of disease containment, human safety, etc.) with the possible harms (ex: welfare outcome for the poultry, severity of the situation, environmental impact, etc.). For the ethical analysis, the outcome options include the following approaches:

- Absolutely justified approach
 - Method causes the least welfare harm, and there is no better option for the animals.
- Contextually justified approach
 - Method is the best *available* option for depopulation. There may be other options, but the circumstances (ex: availability of input resources; extreme number of poultry flocks to be depopulated in a short time period, etc.) are such that other methods cannot be implemented.
- Non-justified approach
 - Better alternative methods/actions are available for consideration and should be used. The easiest and cheapest method may not be the best choice or the most ethical choice. Thus, if the method is not permitted and/or the approach is not justified, it should not be deployed and other available options should be utilized.

When unforeseen circumstances result in disruptions that do not result in increased risk for animal suffering and/or increased risk for human health, humane euthanasia of the animals should be considered instead of emergency depopulation. In such circumstances, the AVMA Guidelines for the Euthanasia of Animals³ should be used as the reference, and approved methods of euthanasia should be used following company and/or industry welfare guidelines and expectations.

³Dr. Dorothy McKeegan, University of Glasgow (Presentation during depopulation webinar, sponsored by International Poultry Welfare Alliance, May 2020)

⁴AVMA Guidelines for the Euthanasia of Animals (2020) <https://www.avma.org/sites/default/files/2020-02/Guidelines-on-Euthanasia-2020.pdf>

Emergency/Urgent conditions that may necessitate depopulation of poultry flocks

Emergency events that may necessitate the consideration of depopulation of commercial poultry flocks may include the widespread loss of essential survival resources during natural disasters (ex: tornados, earthquakes or floods); non-natural disasters (ex: incidents involving terrorism, bioterrorism, conventional attack, or accidents that result in the loss of structural integrity to the poultry housing); toxic chemical spills or contamination of food and water supplies; zoonotic or a pandemic disease that threatens public health and the food supply; reportable or highly infectious poultry disease in a geographic region or species; and severe market or infrastructure disruption causing significant welfare concerns. Details of these scenarios are included below.

Urgent circumstances that may require the rapid and efficient destruction of a population of poultry include, but are not limited to:

- **Natural disasters:** Depopulation may be required when poultry cannot be removed from harm's way to prevent or relieve animal suffering. Following a natural disaster, farms and/or poultry housing may be damaged to the extent that it is hazardous for personnel to enter buildings safely. Additionally, if farms remain intact but essential services, including animal care and feeding, are unable to be restored in time to prevent animal suffering, depopulation may be required to prevent or relieve animal suffering.
- **Non-natural disasters:** Depopulation may be required during non-natural disasters (such as an incident of terrorism, bioterrorism, accident, loss of structural integrity to the poultry housing, etc.) to prevent or relieve animal suffering and to protect worker and public health.
- **Intoxications or contamination of food/water supplies:** Depopulation of poultry exposed to toxic substances, to contaminants of food and water supplies or other adulterants or intoxicants may require depopulation to prevent real or perceived threats to food safety or immediate or impending danger to poultry welfare from the toxicant exposure.
- **Zoonotic or pandemic diseases:** Depopulation may be required because of real or perceived public health threats, such that poultry can no longer be moved or marketed. Zoonotic or pandemic diseases may complicate or increase the burden of accomplishing depopulation owing to the level of personal protection required to prevent human exposure.
- **Reportable diseases:** Depopulation may be used by state and federal animal health officials as the first line of defense to quickly control and eradicate a reportable poultry disease by preventing further disease replication in infected, exposed, or at-risk flocks. Stop movements may be implemented in disease control areas and result in the need for depopulation of poultry on non-infected farms.
- **Highly infectious avian diseases:** Within a geographic area, timely depopulation of infected and susceptible poultry flocks may be required to prevent pathogen replication and spread to nearby poultry flocks resulting in further losses and additional bird suffering.
- **Severe market or infrastructure disruption:** Depopulation may be required for any eventuality that reduces or eliminates the marketability of poultry, the ability to transport poultry to processing, or the ability to slaughter poultry at processing. However, depopulation for severe market disruption should only be considered when the disruption has created extraordinary circumstances where poultry may need to be depopulated as a final option when no other solutions exist. Depopulation for this circumstance should be considered to prevent animal suffering and negative poultry welfare outcomes.

Choosing a Depopulation Method

The choice of depopulation method, the handling of poultry, and the disposal of animal carcasses should adhere to strong ethical standards and must also comply with state and federal laws. Depopulation decisions must balance the welfare of the poultry against the immediate risk to humans, other populations of animals, and the environment. Decisions should be made with consideration of professional, ethical, and technical aspects as well as the availability of infrastructure, equipment, and trained personnel, human and animal welfare, and disposal and environmental outcomes.

Examples of practical considerations when evaluating depopulation options should include but are not limited to:

- status of building infrastructure where poultry are housed. The expertise of health and safety professionals, as well as structural engineers, should be considered.
- severity of the situation (number of houses/farms involved, number of people that may be involved)
- availability of trained, competent personnel with knowledge, expertise, and certification (ex: respirator-fitted, confined space certification (OSHA), euthanasia training, etc.)
- biosecurity protocols & zoonotic disease risk
- personal health, safety & well-being of the depopulation team
- cost/availability of equipment for the method/available resources for the function of equipment
- disposal method/option for carcasses
- communication & ability to maintain confidence and trust (internal, customer, public)

Depopulation Methods Categories

The methods involved in depopulation will reflect the severity of the emergency in question and will also include trade-offs, as mentioned earlier, with the harm/benefit ethical analysis. Depopulation methods may not be congruent with euthanasia methods since they involve the mass termination of large populations of animals, are only carried out during urgent circumstances, and as much consideration as practicable is given to the welfare of the animals. The AVMA Guidelines for the Depopulation of Animals² define the methods in these three categories:

Preferred methods are given the highest priority and should be used preferentially when circumstances allow reasonable implementation during emergencies.

Permitted in constrained circumstances methods are permitted only when the circumstances of the emergency are deemed to constrain the ability to reasonably implement a preferred method. Potential constraints include, but are not limited to, mandated disease response time, human safety, animal access, deployable resources/equipment, infrastructure status, and disease transmission risk.

Not recommended methods should be considered only when the circumstances preclude the reasonable implementation of any of the preferred or permitted in constrained circumstances methods and when the risk of doing nothing is deemed likely to have a reasonable chance of resulting in significantly more animal suffering than that associated with the proposed depopulation method. Examples include, but are not limited to, complete inability to safely access animals for a prolonged period of time, or any circumstance that poses a severe threat to human life.

Poultry Depopulation Methods (from AVMA Guidelines for Depopulation & AAAP Recommendations)

	Preferred Methods	Permitted in constrained circumstances	Not recommended
Floor-reared / confined poultry, including aviary style housing	<ul style="list-style-type: none"> • Water-based foam generators • Water-based foam nozzles • Whole-house gassing • Partial-house gassing • Containerized gassing • Euthanasia methods (cervical dislocation, mechanically assisted cervical dislocation, captive bolt gun) 	<ul style="list-style-type: none"> • VSD plus (VSD+) • Euthanasia methods (gunshot, exsanguination, decapitation) 	<ul style="list-style-type: none"> • VSD alone • Controlled demolition
Cage-housed poultry	<ul style="list-style-type: none"> • Whole-house gassing • Partial-house gassing • Containerized gassing • Euthanasia methods (cervical dislocation, mechanically assisted cervical dislocation, captive bolt gun) 	<ul style="list-style-type: none"> • Compressed air foam • VSD plus (VSD+) 	<ul style="list-style-type: none"> • Water-based foam generators • Water-based foam nozzles • VSD alone • Controlled demolition • Gunshot
Outdoor-access poultry	<ul style="list-style-type: none"> • Containerized gassing • Euthanasia methods (cervical dislocation, mechanically assisted cervical dislocation, captive bolt gun) 	<ul style="list-style-type: none"> • Water-based foam generators • Water-based foam nozzles • Partial house gassing • Euthanasia methods (gunshot via firearm or pellet gun, exsanguination, decapitation) 	<ul style="list-style-type: none"> • VSD alone • Controlled demolition

Note: Ventilation shutdown PLUS (VSD+) is defined as VSD plus heat, VSD plus CO₂, or VSD plus heat and CO₂. VSD+ must be applied in a manner that will produce a 100% mortality rate that meets the AVMA classification category permitted in constrained circumstances. Appropriate implementation of VSD+ requires a scientifically validated protocol and strict engineering process control to ensure death occurs as rapidly as possible. Ventilation shutdown alone (VSD alone) is not recommended.

Regardless of the depopulation method selected, a backup euthanasia method should also be selected to be utilized in the event any individual birds need to be euthanized.

The methods listed above are appropriate for poultry depopulation based on the available scientific literature and experience. However, this list may not be all-inclusive. Per AVMA guidelines & AAAP recommendations, the appropriateness of alternative options should be assessed using the following criteria:

- Ability to induce loss of consciousness followed by death in a timely manner with a minimum of pain or distress.
- Reliability and irreversibility of the method to result in death of the animal.
- Compatibility with the safety of humans, other animals, and the environment.

- Potential psychological or emotional impacts on personnel and sensitivity to public sentiment regarding the destruction of large numbers of animals.
- Availability of agents, carcass-processing and disposal venues to handle the volume.
- Ability to maintain the equipment needed for depopulation in proper working order.
- Compliance with legal requirements.

Additional Depopulation Considerations

Every situation where depopulation is considered will be unique due to the limitations and constraints imposed by the type (age) of the poultry, the emergency, resource availability, geography, site variation, local or federal regulations, etc. When choosing a depopulation method, the factors highlighted here must be considered. Producers should work with their poultry and/or state veterinarian to discuss and document these factors and justification for the chosen depopulation method.

Legal requirements

Select a method that complies with legal requirements (state or federal). State laws or local ordinances (ex: mortality/waste management, access to needed resources (ex: water), etc.) must be followed when considering a depopulation method. Depopulation planning requires knowledge of legal requirements, verification of compliance with current regulations and may require prior permission.

Poultry disease characteristics

Select a method that takes into consideration the scope of the disease outbreak, the presumptive/confirmed pathogen involved, the number of poultry to be depopulated, and resource availability in terms of biosecurity restrictions. The poultry or state veterinarian will provide guidance with the following:

- Understanding how the epidemiology, transmission route, and pathogenesis of the disease-causing agent will impact the timeline for depopulation, labor needs and worker safety precautions, the physical condition of poultry, scope of depopulation, carcass disposal method, and cleaning and disinfection.
- Evaluation of the current and ongoing disease status (ex: infected, contact, or clean) of the site, which will help define the timeline and scope of depopulation.

Time constraints

Select a method with the ability to achieve the necessary throughput to accomplish depopulation within the established time constraint. State/federal regulatory authorities may establish an expected timeline for flock depopulation during a notifiable disease outbreak, and the method must be implemented to achieve this.

Ownership and indemnity

Depopulation planning and coordination are essential when the owner of the poultry differs from the owner of the farm (ex: contract grower). If an appraisal and indemnity process is necessary to offset the financial losses (ex: insurance company or government authority approval), this should be considered before a method is implemented. Planning must be done expeditiously as delays may impact bird welfare.

Personnel availability

Select a method that is aligned with the number of personnel needed, the availability of personnel, and the experience/training/certification requirements of available personnel.

- Consider the amount of downtime required if personnel are moving between sites to perform depopulation. Consider the training/experience required to achieve success with the depopulation method.
- Create work/shift schedules that allow for some downtime to protect psychological human well-being and safety.

Worker health and safety

Select the method based on varying risks for worker health and safety and the availability of appropriate personal protective equipment (PPE). Worker health & safety must be a primary consideration when choosing & implementing the depopulation method.

- The type and/or availability of personal protective equipment (PPE) required may impact which method(s) can be utilized and/or how the chosen depopulation method is performed.
- Designate a trained, competent individual to address and ensure worker health and safety during all phases of the depopulation process.

Operator and observer impact

Select the method in consideration of the aesthetics and the impact the depopulation will have on observers, operators, and farmers/farm staff. Make appropriate social services and mental health support resources available to all participants in the depopulation process, regardless of the method used.

Public perception

Select the method that is proportional to the scope and urgency of the situation. Consider how and where the method can be performed to limit the number of observers, protect public safety, advocate the commitment to animal welfare and human safety during crisis situations, and maintain confidence and trust.

General Considerations for Depopulation Methods

1. Depopulation with Foam

Preferred method to use when:

- ◆ Resources (trained staff, water, foam concentrate, functional equipment) are readily available
- ◆ Disposal method is not inhibited by the use of foam product (ex: composting in-house, burial, landfill are the disposal methods that are planned after the depopulation is complete)
- ◆ Poultry housing is fully-intact to contain the foam and birds, and birds are floor reared.
- ◆ Poultry housing is partially damaged, but birds/foam can still be contained in the area for depopulation, and the non-damaged house/equipment will be salvaged for future use
- ◆ Human safety precludes the use of other preferred methods (ex: number of people involved during zoonotic crisis, lack of respirator-certified staff, etc.)
- ◆ Sufficient foam can be generated to ensure at least 1 foot of foam above the head height of all poultry in the house
- ◆ Disease situation requires minimizing potential fomite (feather/dust/etc.) spread

Not to be used if:

- ◆ Insufficient water is available (provided on-site or sourced) to ensure complete death of poultry
- ◆ Temperature is extremely low (<20F) which can result in equipment freezing & inadequate foam
- ◆ Inadequate foam concentrate is available to ensure the correct size of foam and volume to cover birds
- ◆ Trained staff are not available and/or must be limited due to zoonotic potential of pathogen
- ◆ Depopulation cannot be completed within the desired time frame
- ◆ Disposal method of carcasses is incompatible if foam product is used (ex: rendering)
- ◆ Amount of poultry to be depopulated (number of houses, number of sites, number of birds) exceeds the capacity of resources (water, foam concentrate, staff, foaming equipment, etc.) or if poultry are in multi-tiered cages
- ◆ House structure is not conducive to proper dispersion of the foam

Necessary supplies/parameters to ensure method can be completed correctly:

- ◆ **WATER:** Potable water must be provided (to avoid impurities) from a portable holding tank or tanker truck. For this reason, the use of groundwater (pond, lake, or stream) is not recommended. Resource availability for copious amounts of water should be assessed prior to initiating the depopulation.

- ◆ **FOAM CONCENTRATE:** Class A foam concentrate must be used as recommended by the foaming equipment manufacturer (ex: SILV-EX, PHOS-CHECK WD881, etc.). Availability for foam concentrate should be assessed prior to initiating the depopulation.
- ◆ **FOAMER EQUIPMENT:** The primary foam units utilized in the United States are from KIFCO and the North Carolina Department of Agriculture (NCDA).
- ◆ **SET-UP & IMPLEMENTATION OF METHOD:** If the birds do not occupy the majority of the house, it is best to drive them into a smaller area for containment (ex: use plastic or tarps to reduce floor area for birds and reduce the volume of foam needed). If nests are present, they should be inaccessible to the birds prior to the beginning of depopulation.
 - **Floor Operations WITH Slats:**
 - For human safety reasons and efficacy of the foam application, the foam should not cover the slats in operations that have a scratch & slatted area.
 - If possible, all birds should be driven into the scratch area during the set-up process. Use tarps or plastic to contain the birds in the floor area and to build a ‘wall’ where the foam will be contained and drive the birds into this area. Tarping the edge between the slats and scratch area is a critical step to ensure all birds are covered by the foam.
 - Ensuring depopulation occurs in the scratch area will improve the ease of mortality removal and optimize human safety.
 - **Floor Operations WITHOUT Slats:**
 - If poultry occupy the entire house and the majority of the floor space (ex: broilers & the stocking density is near capacity), the entire house will need to be foamed to ensure effective depopulation of the entire flock. In this scenario, birds do not need to be driven to a confined area. Additionally, if any floor-based equipment is present (ex: migration tubes, enrichments, etc.), they should be removed to avoid potential trip hazards for human safety and also to optimize bird distribution and behavior in the containment area.
 - If poultry occupy the entire house but do not occupy the majority of the floor space (ex: density is low due to young poultry, disease-related mortality has reduced bird numbers, etc.), birds should be driven to a designated confined area. This area can then be foam-filled to ensure effective depopulation. By using a contained area, foaming will be more efficient & mortality removal will be quicker.
 - If poultry occupy different areas within the house (ex: pens are used to separate portions of the flock), the divider can be removed to create one larger flock. In this case, all birds can be driven to one end or central area where they will be contained to ensure effective foaming.
- ◆ **EQUIPMENT/STAFF TO REMOVE MORTALITY:** Planning should include the intended method of removal and disposal for the mortality after the completion of the method. Birds depopulated with foam cannot go to rendering. If in-house composting will be used after the method, this is not relevant. However, for burial, outside composting, etc., the following should be considered:
 - **Foam removal:** The foam will naturally begin to dissipate after the method. However, once birds are confirmed to be dead, leaf blowers or industrial fans can be used to accelerate the removal of the foam from the mortality. Once this has occurred, mortality can be removed from the house.

- Carcass removal via mechanical tools/personnel: Use a tractor/loader with a scoop to remove the dead birds from the house. Additional staff may be needed to help pile the mortality for the loader.
- Carcass removal via personnel: Consider using additional personnel (ex: contract staff) to help with the removal process as this can be physically exhausting for staff. When planning, birds may be contained and foamed near an exit door to help facilitate the removal process.

◆ **ADDITIONAL SUPPORT & OVERSIGHT:** Consider contacting foam equipment manufacturers, other local poultry companies, university extension staff, and state animal health officials for support and assistance. Many have the equipment (tanker trucks, foaming equipment, etc.) and trained staff who can help during emergency scenarios.

General Considerations for Depopulation Methods

2. Depopulation with Carbon Dioxide (CO₂)

Preferred method to use when:

- ◆ Resources (trained staff, CO₂, functional equipment) are readily available and deliverable on-site
- ◆ Poultry housing and/or containerized gas unit (CGU) is fully intact to contain the birds and gas
- ◆ Safety parameters are fully met (ex: respirator-certified staff, confined space certification (OSHA)) to ensure correct implementation

Not to be used if:

- ◆ Insufficient gas is available (provided on-site or sourced) to ensure complete death of poultry
- ◆ House is damaged and/or cannot be completely sealed to contain gas
- ◆ Low ambient temperature cannot be mitigated and could result in equipment freezing & impeding gas flow
- ◆ Trained/safety-certified staff are not available
- ◆ Team members/staff must be limited due to the zoonotic potential of pathogen
- ◆ Depopulation cannot be completed within the mandated time frame
- ◆ Amount of poultry to be depopulated (number of houses, number of sites, number of birds) exceeds the capacity of resources (volume of gas, staff, gas delivery equipment, etc.)

Necessary supplies/parameters to ensure method can be completed correctly:

- ◆ **GAS (CO₂) SUPPLY:** Consult with your compressed gas supplier for specific recommendations and engineering oversight. The total gas volume needed to achieve effective concentration is a function of the flow rate and container volume. For the purposes of this technique, the container volume is the full or partial poultry house, or an enclosed containerized gas unit (CGU) in which poultry and the gas will be fully contained.
- ◆ **HOUSE SEALING EQUIPMENT:** The building will need to be sealed to ensure gas will be higher than the head height of the tallest birds, since CO₂ is heavier than air. Additional equipment and supplies may be needed to ensure human health and safety.
- ◆ **STAFF:** Carbon dioxide poses a moderate risk to human safety. Personnel should be cautious of CO₂ exposure. Risks can be mitigated by using wearable gas monitors and allowing complete ventilation of the container or house before entry for inspection and removal of dead birds. Cryogenic gloves and goggles should be worn by personnel working around the vaporizer chamber. Having a trained Health and Safety officer present is recommended to ensure that all safety precautions have been implemented and monitored.
- ◆ **EXTERNAL TEMPERATURE:** Extra energy may be needed to maintain the temperature of the vaporizer and heat exchanger so they will function correctly in cold ambient temperatures.

◆ **MORTALITY REMOVAL:** Once the Health & Safety officer has deemed the house/container safe for personnel entry, dead birds can be removed via hand or with mechanical tools.

- Carcass removal via mechanical tools/personnel: Use a tractor/loader with a scoop to remove the dead birds from the house/container. Additional staff may be needed to help pile the mortality for the loader.
- Carcass removal via personnel: Consider using additional personnel (ex: contract staff) to help with the removal of dead birds as this can be physically exhausting for staff.

Primary resources required:

- **The equipment utilized for whole house gassing is specialized. Engineering oversight should be utilized to ensure proper supplies and high-pressure CO₂ liquid.**
- **Vaporizer chamber** should be a gas-tight vessel that has a pressure-relief valve and is capable of withstanding 500°F to 600°F. Examples include 55-gallon metal drums, 250-gallon used propane tanks, and polyethylene bags. This chamber can be used to sublimate dry ice accumulation back into gas.
- **Pressure drop valve** rated for pressure and low temperature to prevent dry ice formation in the feed hose or truck valve. Check with your CO₂ supplier to ensure you have the correct connection available for the truck to connect with the vaporizer chamber.
- **Heat enclosure** is designed to improve heat transfer to the vaporizer chamber. The heat capacity and the number of heaters will be determined by the desired CO₂ flow rate. Heat input can be supplied from several sources, including kerosene, torpedo-style heaters.
- **Heat exchanger** to increase the gas temperature to near ambient temperature. Examples include adding a metal heat exchanger coil inside the heat enclosure or a geothermal earth tube.
- **Polyethylene bags (optional)** can be used to store gas onsite and help provide a more consistent flow of gas to the depopulation chamber.
- **Flow regulation** using a field-constructed venturi and monometer. A blower can be used to move the gas from the storage bags to the chamber.
- **Airtight container** sized to accommodate the farm needs and vaporizer capabilities. The floor of the container should be a non-slip surface. The container must be equipped with inlet and outlet valves. Because carbon dioxide is heavier than air, the container's outlet valve should be located at the top. This way, the container can be filled with carbon dioxide, while the displaced air can escape. Examples of containers used for depopulation include earthen pits, sealed trailers or dump trucks, shipping containers, roll-off solid waste dumpsters, and temporary corrals constructed of wire fence, plywood, and plastic sheeting.
- **CO₂ monitor** with extended reading capacity to ensure desired level of CO₂ is attained within the barn to cause death, and to ensure that the barn has been vented properly and is safe for re-entry of personnel.
- **Ancillary resources:**
 - **Front end loader** for carcass removal from the container.
 - **Backhoe (optional)** to dig earthen pits for CO₂ container or trenches for earthen tubes

General Considerations for Depopulation Methods

3. Depopulation with Ventilation Shut Down PLUS (VSD+)

Permitted under constrained circumstances when:

- ◆ Resources for other methods (personnel, gas/foam supplies, etc.) are not available for the urgent situation
- ◆ Quantity of houses (number of birds, number of farms) is exceedingly high and depopulation needs to occur quickly to limit welfare harms (suffering of animals, disease spread, etc.)
- ◆ If urgent disease control situation for a reportable disease (ex: HPAI, END) mandates depopulation within 24 hours and other preferred methods cannot be implemented to achieve the required timeline
- ◆ Poultry housing is fully intact to allow the area to be correctly sealed for process
- ◆ Safety parameters for personnel are fully met (ex: respirator-certified staff)
- ◆ If the zoonotic potential of disease is high and the number of staff involved must be limited
- ◆ Additional supplies can be installed to facilitate VSD+ method (ex: supplemental heat, gas, heat+humidity) to ensure lethal conditions are achieved in the house as quickly as possible

Not to be used if:

- ◆ Preferred methods can be utilized and/or are available options
- ◆ House is damaged and/or cannot be completely sealed to allow for the method to be carried out
- ◆ Adequate supplies (see below) are not available and/or cannot be delivered to ensure that method results in 100% lethality within the expected time frame for death (<1.5hrs.)
- ◆ Note for VSD+CO₂: should not be used if a sufficient quantity of gas (CO₂) is not available on-site and/or is not able to be delivered to implement the method correctly so that complete death of poultry will occur within the expected time frame; or if trained/safety-certified staff are not available for work within the confined area after the method is implemented.
- ◆ Note for VSD+heat: should not be used if supplemental heat cannot be provided/added to the house to implement method correctly and to ensure complete death within the expected time frame

Necessary supplies/parameters to ensure method can be completed correctly:

- ◆ **PREPARATION FOR VSD+**: Ventilation shutdown plus (VSD+) includes sealing up the building (shutting inlets, etc.) and turning off and sealing sidewall ventilation fans. VSD+ requires the use of additional heat sources and/or the addition of CO₂ to achieve lethal conditions as quickly as possible so the depopulation technique is both effective and efficient. For housing with poultry in multiple tiers, fans inside the house may need to be used and mixing should be used to prevent stratification of heat or CO₂ concentrations between the top and bottom levels of a multi-level caged system. Configuration

for VSD+ will be impacted by the age and size of the facility, the insulation of the facility, the ventilation system, the ability to adequately seal fans, louvres, doors, and windows, and the number and size of animals in the facility⁵. After VSD+ is complete and ventilation resumes in the facility, death can be confirmed, and a backup euthanasia method applied to any remaining live animals.

◆ **STAFF:** Minimal personnel are needed to implement VSD+. Most labor needs will be associated with carcass removal from the facility. Throughput will be dependent on the size of the animals and the time needed for carcass removal. Personnel should not enter the facility while VSD+ is in progress. Allow the facility ventilation to resume before personnel enter the barn to confirm death and remove carcasses.

◆ **EXTERNAL TEMPERATURE:** Depending on facility design, low ambient temperatures, low relative humidity, and high wind speeds may impact VSD+ application.

◆ **EQUIPMENT TO REMOVE MORTALITY:** Carcass removal can be done by hand or with a front-end loader. There are no carcass disposal restrictions.

Primary resources:

- **VSD+ should be applied with a scientifically validated protocol and with strict engineering process control.**
- **Heat sources** should be used to increase and maintain lethal temperatures for the VSD+heat technique. Existing heat sources in the barn may be used and supplemental heat sources can be provided to ensure that lethal conditions are achieved for VSD+heat. Temperature monitoring devices should be placed inside the house to ensure process control.
- **Carbon dioxide** should be used to increase and maintain lethal gas levels for the VSD+CO₂ technique. Refer to the carbon dioxide section in this document for additional details on CO₂ administration. CO₂ monitoring devices should be placed inside the house to ensure process control.
- **Plastic sheeting or tarps** can be used for any of the VSD+ methods to decrease the headspace in the house and to ensure lethal conditions are achieved at bird level.
- **Sprayers, foggers, or drip coolers** can be used to increase the humidity within the facility during VSD+ techniques (VSD+heat and VSD+CO₂). Additional humidity with no airflow will aid in the development of lethal conditions. Relative humidity monitoring devices should be placed inside the house to ensure process control.

⁵Eberle-Krish, K.N., Martin, M.P., Malheiros, R.D., Shah, S.B., Livingston, K.A. and Anderson, K.E., 2018. Evaluation of ventilation shutdown in a multi-level caged system. *Journal of Applied Poultry Research*, 27(4), pp.555-563.

Sample Checklist or Worksheet for Documentation of Depopulation Decision(s)

Date: _____ Location: _____ Reason(s): _____

Type and number of poultry for depopulation: _____ # houses: _____

Level of **urgency** for animal welfare/health: _____

Human health & safety concerns: _____

Additional restrictions/mandates to consider: _____

AVMA **preferred options** for Depopulation to consider: _____

Ethical evaluation (note who conducted & any concerns below):

- Environmental assessment: _____
- Human safety assessment: _____
- QA/biosecurity assessment: _____
- Animal Welfare assessment: _____
- Reputational/societal assessment: _____

Supplies & personnel needed & available for depopulation method(s):

METHOD: _____ SUPPLIES: _____ Available : _____

PERSONNEL TRAINING: _____ Available: _____

OTHER INPUTS/RESOURCES: _____

METHOD: _____ SUPPLIES: _____ Available : _____

PERSONNEL TRAINING: _____ Available: _____

OTHER INPUTS/RESOURCES: _____

Possible disposal method(s) for mortality: _____

(Reason(s): _____)

Location options for disposal: _____

Contacted regulatory officials for approval: _____

Method of depopulation that will be used: _____

(Reason(s): _____)

Post-Depopulation Review notes: _____ (date & who conducted)

Effectiveness of process (time/outcome): _____

Challenges/concerns during/after process: _____

Notes to improve decision-making / depop process: _____

References

- 1 – AVMA Humane Endings (<https://www.avma.org/resources-tools/animal-health-and-welfare/humane-endings>)
- 2 – AVMA Guidelines for Depopulation (2019) (<https://www.avma.org/sites/default/files/resources/AVMA-Guidelines-for-the-Depopulation-of-Animals.pdf>)
- 3 – Dr. Dorothy McKeegan, University of Glasgow (Presentation during depopulation webinar, sponsored by International Poultry Welfare Alliance, May 2020)
- 4 – AVMA Guidelines for the Euthanasia of Animals (2020) <https://www.avma.org/sites/default/files/2020-02/Guidelines-on-Euthanasia-2020.pdf>
- 5 – Eberle-Krish, K.N., Martin, M.P., Malheiros, R.D., Shah, S.B., Livingston, K.A. and Anderson, K.E., 2018. Evaluation of ventilation shutdown in a multi-level caged system. *Journal of Applied Poultry Research*, 27(4), pp.555-563.