

Project Title: National Pork Board and Michigan State University Depopulation and Carcass Management Demonstration Field Days

NPB Project Identification Number:

Principal Investigators:

Dale W. Rozeboom
Department of Animal Science
2209 Anthony Hall, 474 S Shaw Lane
East Lansing, Michigan 48824
517-355-8398
rozeboom@msu.edu

Madonna Benjamin
Department of Large Animal Clinical Sciences
A202, 736 Wilson Rd
East Lansing, Michigan 48824
517-614-8875
gemus@msu.edu

Institution: Michigan State University

Date Report Submitted: March 15, 2024

Industry Summary:

On October 23 and 24, 2023, Michigan State University hosted a day-and-a-half event for the National Pork Board (NPB) to educate stakeholders in the swine industry on methods of depopulation and carcass management in the event of a highly consequential disease response. Two demonstrations on how to achieve desirable outcomes with 1) depopulation and 2) carcass management were the primary components of this learning activity, but classroom presentations, open discussion, surveys, and question/answer sessions were also included. Participants included selected representatives and stakeholders from AASV (American Association Swine Veterinarians) member veterinarians, MDARD (Michigan Department of Agriculture and Rural Development) regulatory representatives, members of AVMA (American Veterinary Medical Association) Guidelines for the depopulation of animals working group, and producers invited through the NPB national task force on depopulation. For the depopulation portion of this program the focus was to provide a comprehensive overview of four different methodologies for mass depopulation of swine. For the carcass management portion of this program, the intent was to improve the efficiency of mass carcass management from barn to compost windrow. Conducting this program at a public university required significant planning to obtain approvals for human, animal, and environmental safety. Communication and documentation were completed with awareness of the public sensitivity arising from the sacrifice of swine during the depopulation demonstration. To support the protection of sensitive subject matter and participant safety NPB retained SES, Inc. (Lenexa, KS).

Depopulation Demonstration

Attendees learned about four methods of swine depopulation and tools to assist in human resiliency. Details about conducting this educational program were included in the *National Pork Board & Michigan State University Depopulation Field Days Participant Guide*. Dr. Andrew Bowman and crew from The Ohio State University demonstrated depopulation using water-based foam. Ms. Lucia Hunt and colleagues from the Minnesota Department of Agriculture demonstrated the use of gaseous CO₂. Mr. Jeff Hill and associates from Agricultural Emergency Services, Inc. demonstrated depopulation with N₂ filled foam. These methods were described by operators on both days of the program. On the second day of the program, three trailer loads of 22 to 26 head were depopulated using each of these approaches. The methods were 100% effective in the mass depopulation of swine. Attendees observed and compared approaches. They were able to assess the time and management required from loading of hogs to unloading of carcasses. Regulatory and policymakers, and invited stakeholders, departed with firsthand observations with which to consider updates to

the AVMA Guidelines on Depopulation of Swine. Based on their willingness, presenters may or may not have provided procedural documentation to attendees.

On day one, Dr. Marie Culhane from the University of Minnesota conducted a bench-scale demonstration of a second approach to high expansion N₂ foam technology (HEFT).

The American Association for Swine Veterinarians (AASV) *Animal Depopulation Resiliency Check-In Tool* (included in Participant Guide) for people directly or indirectly exposed to animal depopulation, was presented, and made available to attendees.

Carcass Management Demonstration

From the carcass management demonstration, the use of tub grinder mixer-wagons to reduce carcass size and conserve resources was shown to be effective for the prompt decontamination treatment through composting. Two pull-type, twin-screw, tub grinder mixer-wagons were used. The discharge conveyors had been modified to pile mixed material up to 6' high. The composting of swine carcasses took place on an asphalt pad. A compost windrow was constructed 75' long, 14' wide at the base, 6' in height, and 193 yd³ when completed. The windrow was capped with 6 to 8" ground amendment using the tub grinder mixer-wagons. A tissue density of 25 lb. of tissue per cubic foot of amendment in the windrow core was planned.

The number of times carcasses and compost amendments are mechanically moved is less with the use of tub grinder mixer-wagons than other mechanical approaches. We learned that with four tub grinder mixer wagons and one telehandler, with the compost windrows located close to staging, the carcasses from the depopulation of a 2000-head finishing barn with market-sized swine, could potentially be completed in one 10-hour day. The use of tub grinder mixer-wagons may be the best option for an affected herd in the event of a highly consequential disease outbreak. The resumption of pork production most quickly and at the least expense is likely.

Key Findings:

- Mass depopulation of mature market hogs was demonstrated at a public university.
- MSU provided transparency for all involved. Conversations were opened that may not happen in other venues.
- MSU unit leadership asked the project directors and conference services for critical information about the program plans. Through correspondence, supplemental documentation, and meetings, plans were approved.
- NPB provided an opportunity for education of stakeholders, animal health officials, staff, and producers. A journalist was hosted by NPB.
- Procedures and the throughput of mass carcass management were successfully demonstrated and assessed using tub grinder mixer-wagons.

Keywords:

Swine, educational program, mass depopulation demonstration, mass carcass management demonstration

Scientific Abstract:

Michigan State University's College of Agriculture and Natural Resources and College of Veterinary Medicine in collaboration with the National Pork Board, hosted a 1.5-day event on October 23 and 24, 2023, at its south campus farms and Pavilion for Livestock Education. This educational program focused on demonstrating methods of emergency swine depopulation and mass carcass management for invited representatives and stakeholders. Mass depopulation methods demonstrated using a water-based foam, gaseous CO₂, or N₂ foam. Three trailer loads of 22 to 26 head were depopulated using each of these approaches. The methods were 100% effective in the mass depopulation of swine. The use of tub grinder

mixer-wagons to reduce carcass size and conserve resources was shown to be effective for the prompt decontamination treatment through composting. With a 7-minute mix time, a batch size of 5,000 lb. of carcasses, four tub grinder-mixer wagons, and windrows three minutes from the staging area, an estimated 58,833 lb. of carcasses could be ground, mixed, and placed into windrows per hour. Carcasses weighing 290 lb. at the time of depopulation of a fully populated 2000-head finishing unit, could be placed into compost windrows in about 10 hours. Demonstrations provided information to consider in updating guidelines for the mass depopulation of swine and guidelines for managing mass accumulation of carcasses.

Introduction:

Depopulation Demonstration

Depopulation of swine may need to be implemented for a variety of reasons, including foreign animal disease introductions, agroterrorism, intoxications or adulterations, radiologic or nuclear incidents, and natural disasters (Leary et al., 2019). In 2018, an outbreak of African Swine Fever in China prompted Secure Pork Supply, a foreign animal disease preparedness training and traceability program in the United States. In preparation for a potential outbreak of African Swine Fever or other Foreign Animal Diseases (FAD), state and federal agencies have prepared many farms and participated in emergency planning and mock animal disease outbreak exercises. However, due to widespread human illness caused by COVID-19 among farm caretakers, feed providers, and workers at the slaughter plant, the results were not only interruptions in the supply chains for caregiving, feed, and transport but also the slowdowns or closures of packing plants. The result of the market disruption was overcrowding of the barns, which jeopardized the welfare of the pigs due to inadequate access to food and water.

While the American Veterinary Medical Association (AVMA) working group had recently developed and published guidelines for the depopulation of livestock (AVMA Guidelines for the Depopulation of Animals: 2019), commercial barns were limited in plausible methods. The preferred method using barbiturate overdose was not feasible, and due to the disruption of available human and material resources such as ballistics and CO2 gas, producers were limited in their choice of depopulation methods, resulting in the implementation of untested methods and mental stress to farmers and workers.

In rapid response, the National Pork Board (NPB), through Pork Checkoff Research dollars, prompted research requests for proposals for depopulation methods that are safe, dependable, and able to induce unconsciousness and death for a large population of swine. Research outcomes of this RFP include solutions that are both humane and dependable, including water-based foam, nitrogen, and high-expansion nitrogen-filled foam, and refinements to CO2 distribution. To educate and demonstrate these methods and the adjunct training in the management of resulting mortality and to improve the mental health and resiliency of caretakers, the NPB has facilitated depopulation workshops and demonstrations.

Carcass Management Demonstration

Managing carcasses in a composting process following the mass depopulation of a herd requires time, labor, carbon amendments, and mechanical equipment. The overall goal of the composting operation is to minimize these inputs while obtaining maximum decontamination and decomposition of the carcasses and other potentially infected organics on the farm. The mass composting of carcasses would be completed more quickly and with less expensive if the operation used less carbon amendment, a smaller site or footprint, and fewer mechanical movements of carcasses or animal tissue from 'barn to windrow.'

Currently, a mass carcass composting system utilizing a horizontal belt grinder with excavator, bucket loaders and a self-propelled windrow turner is viewed as most favorable. With such, there are five or more mechanical movements from barn to compost:

- 1) Live animals from barn to depop trailer
- 2) Carcasses from depop trailer to the ground at carcasses staging area.
- 3) Carcasses from the ground to the infeed of horizontal belt grinder with use of an excavator.
- 4) Ground tissue-amendment mixture from grinder discharge to bucket of loader, or from grinder discharge to ground. Discharge onto the ground can be avoided if there are two or more 10 yd³ bucket loaders that received the ground tissue-amendment mixture directly into the loader bucket and drive to the windrow to unload the mixture onto the compost windrow base.
- 5) Ground tissue-amendment mixture from ground to loader bucket.
- 6) Ground tissue-amendment mixture from loader bucket onto windrow base.
- 7) Capping of windrow with bucket loader.
- 8) Aeration and further mixing of compost within windrow with compost turner.

Alternatively, the use of tub grinder mixer-wagons, modified to discharge directly onto the windrow base at a height of 6', would involve fewer movements and provide a more uniform ground tissue-amendment mixture. Mechanical movements would be:

- 1) Live animals from barn to depop trailer
- 2) Carcasses from depop trailer to the ground at carcasses staging area.
- 3) Carcasses from the ground into the tub grinder-mixer wagon.
- 4) Ground tissue-amendment mixture from tub grinder mixer-wagon discharged directly onto windrow base.
- 5) Capping of windrow with tub grinder mixer-wagons; or with bucket loader.
- 6) Aeration and further mixing of compost within windrow with compost turner.

Historically, tub grinder-mixer wagons have had less throughput because of the mixing time nearing 10 minutes. Shorter times should be explored. However, the advantage of the mixing is a more uniform mixture of ground tissue and amendment. The benefits of greater uniformity may be enhancing the speed at which optimal compost activity is achieved, as indicated by rapid rise in temperature. Uniformity may decrease the probability of exposed clumps of tissue, which result when using the horizontal belt grinder system. Uniformity may decrease odors and flies.

Earlier this year, NPB completed a preliminary evaluation of animal tissue densities of 10, 15, 20 and 25 lb./ft³ of core amendment. About 100 carcasses were included in the greatest density. The smaller section of windrow with 25 lb./ft³ maintained its shape, flies were modest, and odors minimal. Historically, a tissue density of only 10 lb./ft³ has been recommended. Confirming that a density of 25 lb./ft³ can be used without drawbacks in the composting process, has merit.

Objectives:

Depopulation Demonstration

- In a classroom setting, provide a comprehensive overview of four different methodologies for mass depopulation of swine.
- Demonstrate mass depopulation of swine using three methodologies and equipment required so that stakeholders can see, hear, and discuss learnings.
- Provide participants with a high-quality and safe program, including observational situations to view trailers and methodology.

- Provide support to all participants with professionals and researchers to address questions and concerns.
- Provide a comfortable venue during class time, meals, breaks, and demonstrations.

Carcass Management Demonstration

- To decrease management/mechanical movement of carcasses/animal tissue from barn to compost windrow.
- To estimate carcass throughput when using tub grinder mixer-wagons to construct compost windrows.
- To confirm that with carcass reduction, an animal tissue density of 25 lb. of tissue per cubic foot of amendment is effective, expeditious, and without unacceptable aesthetics.

Materials & Methods:

MSU CANR Events Services

A great deal of planning preceded the actual demonstrations. This was particularly true since the program was being hosted at a land-grant, public, university. Events Services in the College of Agriculture and Natural Resources at Michigan State University was retained to help with the preparation for and the conductance of this program. Assistance and(or) activities which Events Services provide were:

- Create timeline and manage deadlines to ensure project was completed on time.
- Create budget and track expenses to ensure budget remains on track to stay within budget.
 - Seek estimated prices from various units.
- Determine all units involved at MSU.
 - Environmental Health Services
 - Police and Public Safety
 - Risk Management
 - IPF Services
 - Setup
 - Trash services.
 - Equipment and materials
 - Electrical
 - Busing
 - Legal
 - Purchasing/Procurement and Financial Accounting
 - Grants and Contracts
 - Health 4U and MSU Extension
 - University Farm Services
 - Swine farm
 - General farm services
 - Composting
- Collaborate with National Pork Board, SES and MSU Team to create an educational program plan.
 - Work with MSU team to ensure we can create a statement of work that meets MSU's needs and National Pork Board's needs.
 - Develop specific timed rotation plan to ensure all educational objectives can be met.
 - Develop run of show instructions to ensure plan can be executed and all partners involved understand process.

- Provide pre-event onsite support and provide virtual support during program due to event conflict.
- Work with various MSU teams to determine the best site location for both demonstrations.
 - Analyze logistical, environmental and safety advantages and disadvantages.
 - Meet with environmental health services, police and public safety, risk management, university farms and core MSU planning team to determine safety plan requirements, changes required for multiple unit approval on campus.
 - Ensure the project directors had the necessary information to share with state partners at the Michigan Department of Agriculture and Rural Development (MDARD) and the Michigan Department of Environment, Great Lakes, and Energy (EGLE) to ensure we had higher level support for the program.
- Work with core MSU planning team to develop environmental and safety plans for the program and ensure we have incorporated current standard safety plans for university farm locations. Develop contingency plans for weather, protestors, gas and equipment failure, livestock movement issues, sentience, and compost process.
 - Request reviews and incorporate all relevant changes.
 - Ensure we had all approvals to move the project forward for execution.
- Work with MSU legal to determine all requirements for the legal agreement process required by various MSU units to approve the project.
 - Collaborate with demonstration vendors to ensure we had proper safety plans and MSU provided a proper setting, materials and safety protocols for their equipment, demonstrators, and drivers. Help source specific materials and equipment as requested.
 - Negotiate costs associated with various required items to ensure the best price or work to find solutions using resources already available at MSU and work to modify those resources to serve our required needs. For example, using an existing tractor for the compost turning to avoid significant charges to rent an additional tractor.
 - Coordinate and contract logistical needs for the program including tents, tables, chairs, food, equipment, fencing, blockades, and bleachers.
 - Coordinated transportation, including finding, contracting, and arranging busing.
 - Arrange the necessary PPE, including shoe covers, hard hats, and ear protection for the safety of those running the demonstrations, as well as the attendees.
 - Coordinate collaboration with ERAIL program to better utilize hogs for multiple purposes to help project directors create a better justification for IACUC and other animal use approvals.
 - Work with MSU Health 4U, MSU Extension mental health specialists and Dr. Elizabeth Strand to ensure participants and employees had resources and support available to process the experience and use in other similar situations.
 - Work with MSU, SES and National Pork communication teams to ensure proper planning for media coverage and plans for communicating the importance of the program while ensuring no onsite issues during the program.
 - Assist with the creation of an FAQ and other media materials with program coordinators and communications professionals.
 - Schedule dry runs and work through program plans with farm groups, vendors, and clients.
 - Develop route materials and other instructions for each role in the program to ensure the program runs smoothly.
 - Make onsite adjustment with MSU team based on dry runs prior to program to ensure participant safety and program success. Work with MSU units to ensure program expenses are

submitted and properly match the budget within the required period for reimbursement from the National Pork Board.

- These demonstrations were approved by MSU units of IACUC, Environmental Health Services, Police and Public Safety, Risk Management, Legal, Health 4U, Extension, and South Campus Farms.
- Participants and observers signed a waiver and Non-Disclosure Agreement prior to the demonstration.
- Observers were provided with an incident action plan safety analysis.
- Photography and videography were by Bryan Deimeke, SES Inc., only. All others were not allowed.

Participant Guide

Over the course of planning for these demonstrations, a “Participant Guide” was developed (*National Pork Board & Michigan State University Depopulation Field Days Participant Guide*). In it, the two-day event is described in detail, including a complete schedule and maps illustrating the routing of movements of animals, carcasses, and attendees. Portions of the guide pertinent to program methods or operation are included in Appendix A.

Depopulation Demonstrations - Day One Presentations

The didactic portion was held on day one at the MSU Pavilion (4301 Farm Lane, Lansing, MI, 48910). Dr. Andrew Bowman, Ohio State University, led the presentation on research and validation of livestock depopulation using water-based foam. Jeff Hill, Agriculture Emergency Services Inc. presented and demonstrated depopulation using N₂ filled foam. Dr. Lucia Hunt, Minnesota Department of Agriculture, discussed depopulation using CO₂, including a patented method of CO₂ distribution. Dr. Marie Culhane, University of Minnesota, described a small-scale N₂ gas High Expansion Foam Technology (HEFT) generator unit. Dr. Elizabeth Strand, University of Tennessee, introduced the *Animal Depopulation Resiliency Check-In Tool* (included in Appendix A). This tool is a self-administered questionnaire for people to monitor the emotional effects of people experiencing direct or indirect exposure to the depopulation of animals.

An evening tour of the depopulation site, with all equipment ‘off’ allowed initial interactions of participants with depopulation technology and equipment operators.

Depopulation Demonstrations - Day Two Market Hog Depopulation

Dr. Andrew Bowman and the research team from The Ohio State University demonstrated depopulation using water-based foam. Ms. Lucia Hunt and colleagues from the Minnesota Department of Agriculture demonstrated the use of gaseous CO₂. Mr. Jeff Hill and associates from Agricultural Emergency Services, Inc. demonstrated depopulation with N₂ filled foam. Methods used were those of the operators and it was their prerogative, along with NPB, to distribute written documentation of methodology. In planning for this program, Dr.’s Bowman and Hunt submitted operational documentation (Appendix B and C, respectively), addressing critical elements such as time to silence, cessation of movement, and dwell time. A total of 209 market hogs were depopulated during the demonstration over nine repetitions (three per method). Pigs were loaded into customized semi-trailers developed for water-based foam and CO₂ gas depopulation (Photo 1 and 2, respectively). A temporarily modified trash roll-off container was used for depopulation with N₂ filled foam (Photo 3). Between 20 to 25 pigs walked onto each trailer/container per repetition. Time zero was the fill start time of each depopulation method. Time to silence and cessation of movement: With all three methods, cessation of movement occurred within 7 minutes of the start of CO₂, water-based foam, and N₂ filled foam.

The unloading of trailers/container at the Compost Facility Staking Shed constituted the end of each depopulation repetition (Photo 4). Two veterinarians and farm staff were responsible for monitoring pigs for any signs of consciousness. The two-person team walked through the area where depopulated hogs were unloaded, and each was examined for signs of consciousness. Veterinarians were prepared to implement a secondary method of euthanasia, using a captive bolt device.

Carcass Management Demonstration

Carcasses were staged inside the 'Stacking Shed' at the MSU South Campus Composting Facility. Trailers used in the depopulation demonstration unloaded at this location (Photo 4).

This is the open-sided, concrete walled, amendment storage barn at the compost facility. Doors allowing large equipment to pass in and out were located on either side and the end of this staking area. Composting amendment was in the same area so expedite the loading of the tub grinder mixer-wagons.

Pavilion solids (stall bedding and wasted feed) was the composting organic amendment used. It had been accumulated in the Stacking Shed for months prior to this demonstration. This material had been received at the Stacking Shed from the MSU Pavilion for Livestock and Agriculture Education. It is primarily bedding (shavings, wood chips, straw) from stalls, manure, and wasted feed. Because this facility is an exhibition site, stalls are cleaned and re-bedded daily or with great intensity. Depending on the amount of bedding used and daily management, the C:N of pavilion solids ranges from 23 to 49, with moisture ranging from 53 to 71% (Chastain, 2022). Without the addition of any other compostable organic material, pavilion solids are readily compostable alone. When used for this demonstration solids were undergoing decomposition, warm to touch and emitting steam when moved and mixed.

A telehandler (JCB TM320, 130 hp, with 3 yd³ bucket) was used in the staging area to place amendment and carcasses the tub grinder-mixer wagons (Photo 5).

Two pull-type tub grinder mixer-wagons were used, a Supreme 800Twin and a Supreme 900Twin (Wetaskiwin, AB, CA), manufactured with vertical twin-screws fitted with additional blades. The maximum payload for the 800T and 900T was 18,000 and 24,000 lb., respectively. Each was equipped with a four-point scale system for weighing batches. The discharge conveyors (8' and 10' long, for 800T and 900T model, respectively) had been modified by the lessor to be able to pile mixed material up to 6' high. The tub grinder mixer-wagons were leased from Brodie Ag and Industrial Inc. (Tavistock ON, CA), who also provided two experienced people to operate these mixers at the demonstration. Each was powered by a New Holland T7.290 HD, 270 horsepower, Auto Command™ continuously variable transmission, tractor, having three pairs of hydraulic attachment points, and a standard 10-spline PTO shaft designed to transfer power at a maximum speed of 1000 revolutions per minute, or rpm (Photo 6).

The composting of swine carcasses took place on the 150' x 650' asphalt pad located immediately outside of the Stack Shed (Photo 3). The drive from the staging area to the compost windrow was less than 200'. The compost windrow was planned to be 75' long, 14' wide at the base, 6' in height, and 193 yd³ when completed. The base of the windrow (38 yd³) was comprised of pavilion solids which had been ground and mixed prior to placement using tub mixer-wagons and discharged so to spread the solids 1' deep over the 14' x 75' windrow area. The telehandler was used sparsely to achieve uniform depth overall. The core of the windrow was planned to be 104 yd³. To finish the construction of the windrow, 6 to 8" ground pavilion solids (52 yd³) were spread over the windrow core as a cap. Wagons were used to cap the windrow by driving along both sides while discharging ground pavilion solids.

With this windrow design, a tissue density of 25 lb. of tissue per cubic foot of amendment in the windrow core was accomplished (0.37 yd³ of the amendment blend will be used per 250 lb.

carcass). A 1:1 'weight' ratio of amendment to carcass was planned to achieve this animal tissue density. In each batch, 5000 lb. pavilion solids were put into the tub grinder-mixer wagon first (at the bottom), followed by the addition of 16 to 22 carcasses (number adjusted to obtain 5000 lb. of carcass). Tub grinder-mixers were operated for 10 minutes for all batches, but one. The last batch was a partial batch planned to be mixed for 7 minutes. Mix time began with the first addition or bucket full of carcasses. So, the last telehandler bucket of carcasses was ground and mixed in less than 10 minutes. Tub grinder-mixer wagons were discharged onto the base of the compost windrow by driving on one side only (Photo 7).

During the carcass management demonstration Dr. Zac Williams, University of Arkansas, supervised the composting activities.

Following construction of the windrow, temperatures within the windrow were monitored daily according to USDA protocol. The windrow was turned weekly after initial construction, until December 19, using a pull-type, windrow turner (Model: CT1400, Windrow Trner® Composter, Kooima Ag, Rock Valley, IA). The turner's tunnel dimensions were 14' wide by 7' tall. Water was not added at any time.

Results:

Depopulation Demonstration

The depopulation methods demonstrated were effective in ending life. Each method resulted in 100% mortality. No pigs were found conscious by the veterinary team at the time trailers or container were emptied.

Noise from N₂ filled foaming method was less when ran for longer continuous time. To run longer, the foam dispensed onto the ground prior to the filling of the roll off container was carried away by the wind.

Foam from the trailer or container was dispersed along the route from the depopulation site to the Composting Facility Stacking Shed. Biocontainment, if in the event of disease, would be compromised.

The depopulation demonstration provided a platform for exercising the *Animal Depopulation Resiliency Check-In Tool*. The tool has continued to be used at MSU in other settings.

The depopulation demonstration provided Dr. Bowman, The Ohio State University, with a setting to conduct a research survey.

Carcass Management Demonstration

Information in Table 1 describes the ten batches of mortality compost made by placing the pavilion solids amendment with swine carcasses in the tub grinder-mixer wagons.

The first two batches were made while demonstrating the loading, mixing, and discharging of the wagons to attendees. These were not timed for evaluation of throughput as the staging of carcasses was dictated by the timing of the depopulation demonstrations.

From 11:22 AM to 12:05 PM, four batches were completed with all equipment operating continuously to assess the throughput of this system. Eighty to 90 carcasses were reduced/mixed in 43 minutes with a 10-minute mix time. The carcasses from four depop trailers had accumulated in the staging area before this testing.

The duration of a complete batch, or the time from the start of the loading of the tub mixer wagon, through mixing, and until all contents were discharged was measured for each of the last four batches. Batches seven through nine used 10-minute mix times. The last batch, number ten, used a 7-minute mix time. The staging of carcasses during these batches was inconsistent (an outcome of the depopulation demonstration schedule), tub grinder-mixer wagons idled and waited between batches. Wagons were loaded in five minutes or less. Wagons

were driven to the windrow composting site while mixing. Discharging was completed in about five minutes. The average duration of a batch with a 10-minute mix time was 19.6 minutes, which included the time to drive back to the staging area in the Stacking Shed.

Weights of amendment and carcasses in the batches made in the 800T tub grinder mixer wagon averaged 4,413 and 5,426 lb., respectively. This was a 1:1.2 ratio. The average weights of the amendment and carcasses, in batches made in the 900T tub grinder mixer wagon, were 6,520 and 8,153 lb., respectively. This was a 1:1.3 ratio. The last batch, end-of-day cleanup, included remaining carcasses and was not full.

Weights of carcasses exceeded the planned amount of 5,000 lb. per batch. Carcass weight, as determined by the wagon scales was a mixture of carcasses, water, trailer shavings, straw, and pavilion solids (Table 2). A bag of shavings was used in each depop trailer to provide footing for the swine. Also, two straw bales were used to lessen leaking from the back of the trash roll off used as the N₂ trailer. For every trailer of water-based foam there was about 200 gallons of water used. Every trailer of N₂-based foam used 50 gallons of water. One 3-yd³ bucket of pavilion solids was spread onto the Stacking Shed floor with the unloading of each depop trailer to allow veterinarians to walk among carcasses to confirm no sentience and to absorb water. So, after three repetitions of each of these depopulation methods, we had used or accumulated about 13,000 lb. of water, shavings, straw, and pavilion solids in the carcass staging area. These were contained and simultaneously added with carcasses into tub grinder mixer batches. The 7-minute grind-mix time resulted in a similar reduction of the carcasses. For both mixing times, the largest pieces would have been strips of hide, limbs, and large bones about 5' in length (Photo 8). Muscle and lipid tissues were minimally apparent.

Compost temperatures were taken daily at depths of 18 and 36 inches into the windrow. They were taken at five separate locations representing the entire length of the windrow. Daily averages for both depths are presented in Figure 1. Temperatures taken shortly after windrow construction on October 24 indicated what was known, that the pavilion solids were composting in the Stacking Shed prior to use as a mixing amendment. Twenty-four hours later and through the subsequent 8 weeks, temperatures at both depths exceeded 130 degrees F on all days except November 29. On that day, temperatures were recorded 4 hr. after the mechanical turning of the windrow. The turning happened late morning that day, rather than the afternoon of the preceding day. All other turnings occurred on Tuesday afternoon, shortly after the taking of temperatures that day.

Composting activity, as indicated by temperatures, was sustained for eight weeks. Precipitation was the only water addition; both falling onto the windrow and amounts that soaked up into the base of the windrow as it accumulated on the asphalt pad. The windrow was set perpendicular to the slope of the pad so to limit runoff from the pad. Turning distributed the wetter material at the base into the rest of the windrow weekly. Soft tissue was not observed after the fourth week of composting. The turning process reduced the size of bone pieces. At the end of the composting period bone pieces could be crumbled under foot (Photo 9.)

Discussion:

Depopulation Demonstration

The three methods are extremely effective and far exceeded the expectations for mass depopulation of swine described in the AVMA depopulation guidelines, which states that a method should only be used if it results in a greater than 95% death rate in less than one hour.

Attendees were able to observe and compare a complete system of mass depopulation. They were able to have a sense of how long each cycle is required to load hogs onto the trailer and the method of setup and implementation. Regulators, policymakers, and producers were

provided with firsthand observations, with which they can consider revisions to the AVMA Guidelines on Depopulation of Swine.

Attendees learned about managing human resiliency. Observers were able to walk between the depopulation demonstrations, meet with MSU mental health experts, and travel to the compost site to observe the efficacy of the methods and equipment used for mortality management. Professional counseling was available if needed by direct or indirect participants.

MSU unit leadership (DPS, EHS, Legal, Risk Management) asked the MSU project directors and conference services for critical information about the program plans. Through correspondence, supplemental documentation, and meetings, MSU units approved the plans (protesters, safety, environmental protection, social media, SES, Inc. scanning). SES, Inc. would have done more, but MSU needed to do much of this setup since MSU was the host and had units providing oversight of the risks associated with the demonstrations.

MSU now has available depopulation methods to use on campus as needed. MSU addressed their own gaps in depop and continue to address them.

Carcass Management Demonstration

Tub grinder mixer-wagons provide several advantages to the composting process used to manage mass carcass amounts. They do not drive on base to compact it, leaving greater amounts of oxygen in the base, and potentially greater microbial activity quickly. Greater temperatures quickly leading to quicker pathogen destruction. The mixing activity provides for uniform microbial activity throughout the windrow core. Greater tissue densities, 25 lb. of tissue per cubic foot of amendment in the windrow core, can be achieved with carcass reduction and compost mixing using tub grinder mixer-wagons. Body water in the carcasses is managed most efficiently, minimizing the risk of leachate from the compost windrow.

Tub grinder mixer-wagons could be loaded every five minutes. So, one telehandler loader could be used to load a fleet of four wagons every 20 minutes, depending on the rate of depopulation and the distance from staging to windrows or the composting site.

Why batch 6 was only 15 minutes, was questioned. Mix time could not have been 10 minutes with the loading start time and discharge end time recorded. Dr. Williams thought he may have recorded the start loading time incorrectly. It may have also been that the mix time was slightly less.

Use of a 7-minute mix time increases throughput by 15 to 20% over the use of a 10-minute mix time. A standard mix time of 7 minutes could be used for growing and finishing swine. With a 7-minute mix time, a batch size of 5,000 lb. of carcasses, four tub grinder-mixer wagons, and windrows three minutes from the staging area, an estimated 58,833 lb. of carcasses could be ground, mixed, and placed into windrows per hour. If this were a finishing unit and the hogs weighed 290 lb. at the time of depopulation, then 2,086 carcasses could be managed in 10 hr. 15 min workday. In the table we see that more than 5,000 lb. was added per batch, suggesting that the average batch size may be greater, resulting in greater throughput per day than this estimate. Greater amounts daily if 900T wagons could be used, as there was more per batch, in the same 20 minutes of time. The distance from the carcass staging area to the compost windrows is an important consideration when developing estimations of throughput.

With the modified discharge, the forming a 6' high windrow was placed upon the windrow base without any additional mechanical work. The tub grinder mixer-wagons could also facilitate the capping of the windrow.

Carcass management and depopulation processes are part of the greater emergency response challenge and must be viewed as a system. The throughput of depopulation does impact the

speed at which composting is accomplished. Staging of carcasses is critical and affects carcass management flow. Water and other organics used in the depopulation process need to be accounted for in managing the carcasses regardless of the composting methods used. If staging occurs on an impervious surface and water and organics are contained, they then can be added to tub grinder mixer-wagons easily.

Acknowledgments:

Megghan Honke Seidel, MSU CANR Publication and Events Manager, program planning, scope, approvals, financials, execution, and evaluation.

Andrew Den Dekker, President, Brodie Ag & Industrial Inc., tub grinder mixer-wagon vendor and operator.

Al Brodie, Previous owner/CEO, Brodie Ag & Industrial Inc., tub grinder mixer-wagon mortality composting consultant and operator.

Dr. Zac Williams, University of Arkansas Extension Poultry Specialist, composting management.

Dr. Jerry Kehr, MSU South Campus Animal Farms Attending Veterinarian, monitoring depopulated pigs for any signs of consciousness.

Dr. Justin Kieffer, The Ohio State University Clinical Veterinarian, Professional Practice Associate Professor, monitoring depopulated pigs for any signs of consciousness.

Kevin Turner, Manager MSU Swine Farm, and Christopher Rozeboom, Assistant Farm Manager, provision of live market hogs for sale to program.

Tony Boughton, Farm Manager, MSU University Farms and Service Center, host depopulation site and Safety Officer.



Photo 1. Customized semi-trailer used for water-based foam depopulation of swine.



Photo 2. Customized semi-trailer used for CO₂ depopulation of swine.



Photo 3. Modified roll-off used for N2 filled foam depopulation of swine.



Photo 4. Unloading of water-base foam depopulation trailer inside of Stacking Shed.



Photo 5. Telehandler loader used to load tub grinder mixer-wagons.



Photo 6. A tub grinder mixer-wagon and tractor that was used to reduce carcasses, prepare compost, and construct the compost windrow.



Photo 7. The discharging of one batch of compost from a tub grinder mixer wagon onto the base of the windrow.



Photo 8. Large piece of carcass observed after the discharging of all batches managed using tub grinder mixer-wagons.



Photo 9. Examples of bone pieces observed lying next to the base of the windrow after turning on December 12, 2023.

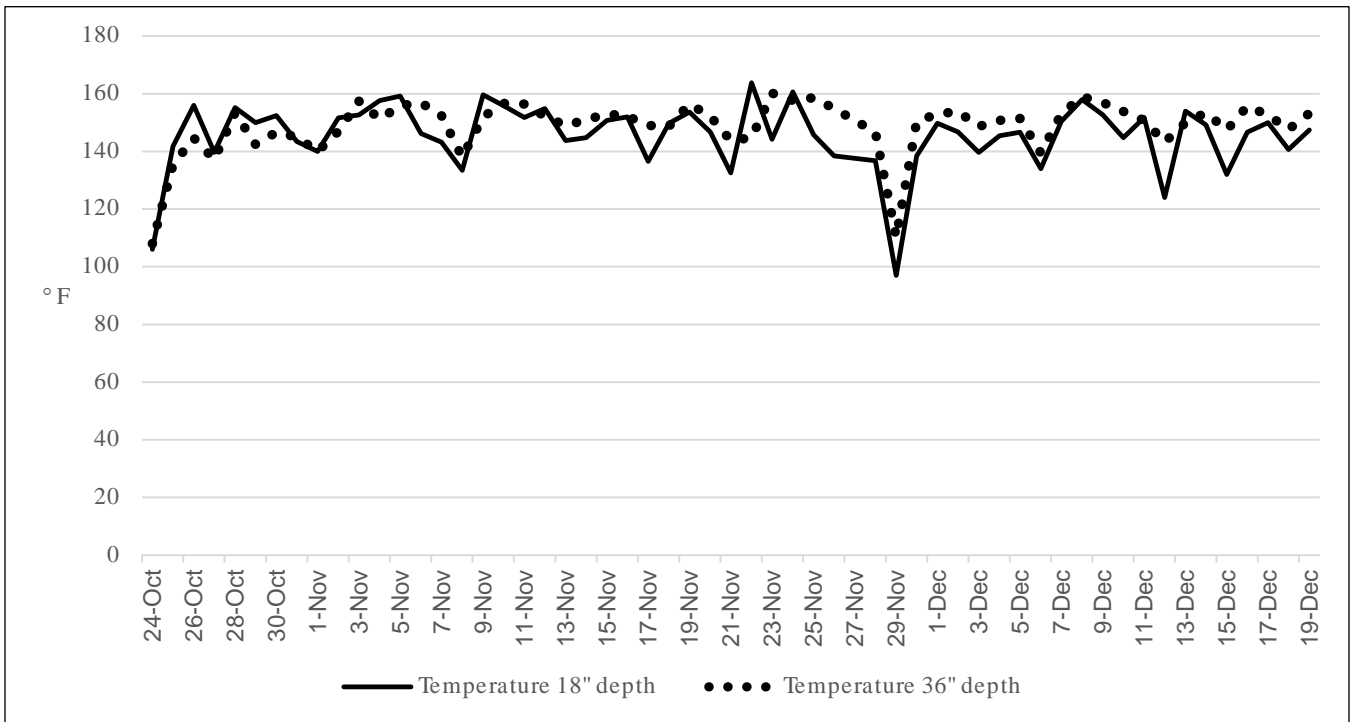


Figure 1. Daily average compost temperatures at depths of 18 and 36 inches into the windrow (average of five locations over the entire length of the windrow).

Table 1. Log of operation times and compost quantities during the demonstration of carcass reduction and mixing by tub grinder mixer-wagons.							
Batch	Mixer	Time Start Loading	Time End Discharge	Total Time, min	Pavilion Solids, lb.	Carcasses, lb.	Total, lb.
Demonstration of tub mixer-wagon loading							
1	900	-	-	-	4,400	5,300	9,700
Demonstration of tub mixer-wagon discharging							
2	900	-	-	-	6,690	8,410	15,100
Throughput assessed							
3	800	11:22	11:42	20	4,400	5,400	9,800
4	900	11:26	11:45	19	6,540	8,250	14,790
5	800	11:44	12:04	20	4,450	5,565	10,015
6	900	11:50	12:05	15	6,300	7,600	13,900
Batch duration assessed							
7	800	12:19	12:39	20	4,515	5,665	10,180
8	900	12:30	12:52	22	6,550	8,350	14,900
9	800	12:41	1:02	21	4,300	5,200	9,500
10	900	12:54	1:10	16	4,220	3,280	7,500

Table 2. Total water and materials accumulated from the entire depopulation demonstration and included with carcasses as they were staged for loading into tub grinder mixer wagons.	
Item	Total, lb.
Bag of shavings (30 lb. ea.) per trailer, 9 trailers	270
N ₂ -based foam, 2 straw bales (30 lb. ea.) per trailer, 3 trailers	180
Water-based foam, 200 gallons per trailer, 3 trailers	4,800
N ₂ -based foam, 50 gallons per trailer, 3 trailers	1,200
Pavilion solids, 1 bucket (3 yd ³) per trailer, 9 trailers	5,940



National Pork Board & Michigan State University Depopulation Field Days

October 23 and 24, 2023

Participant Guide

Version 1.0

WARNING: This document is CONTROLLED UNCLASSIFIED INFORMATION (CUI). It contains information that may be exempt from public release under the Freedom of Information Act (5 U.S.C. 552). It is to be controlled, stored, handled, transmitted, distributed, and disposed of in accordance with policy relating to CUI information (32 CFR2002.14 *Safeguarding*) and is not to be released to the public or other personnel who do not have a valid "need to know" without prior approval of an authorized NPB official.

Contents

Demonstration Background	1
Participant/Observer Guidelines	2
Demonstration Schedule	3
Key Demonstration Contacts	4
Demonstration Communication Plan	4
Classroom and Parking Location	5

Attachments

1: MSU Waiver and NPB Nondisclosure Agreement.....	6
2: Observer Safety Plan	8
3: AASV Animal Depopulation Resiliency Check-In Tool and Worksheet	12
4: Demonstration Site Maps.....	16

Demonstration Background

In 2018, an outbreak of ASF in China created an urgency around foreign animal disease preparedness. Starting in the spring of 2020, the COVID-19 pandemic derailed swine production systems nationwide, highlighting gaps in knowledge for large-scale depopulation and mortality management. In response, pork producers nationwide have identified foreign animal disease (FAD) preparedness as a priority. In response, the National Pork Board (NPB) has run fully functional foreign animal disease response exercises in 2022 and 2023, utilizing multiple methods of depopulation and carcass management. These exercises have both validated research as well as driven additional research as state FAD response plans are put into action. In these exercises, stakeholders have identified several depopulation methods as being most compatible with current disease mitigation and response plans and policies. These methods include the use of water-based foam, Nitrogen (N₂)-filled foam, and Carbon Dioxide (CO₂) gas technologies. During these exercises, these methods are applied independently, never on a side-by-side comparative basis.

To educate a broader set of industry stakeholders about depopulation methods in the event of FAD or other catastrophic event, NPB is facilitating this event to demonstrate the three types of depopulation methods described above. This opportunity is being offered by invitation only and, due to the nature of the subject matter, every precaution is being taken to ensure a safe and secure environment for all involved.

Day 1 will consist largely of classroom presentations ending with a non-operational tour/explanation of the three depopulation technologies, not in operating modes. Day 2 will be devoted to a field demonstration of the three depopulation methods mentioned above. In addition, Michigan State University (MSU) will conduct a presentation on carcass management, focusing on composting. Dr. Andrew Bowman, Ohio State University (OSU), will lead the water-based foam presentation and demonstration; Ms. Lucia Hunt, Minnesota Department of Agriculture (MDA), will lead the presentation and demonstration of gaseous CO₂; and Mr. Jeff Hill, Agricultural Emergency Services, Inc. (AES), will lead the presentation and demonstration of N₂-filled foam. Dr. Marie Culhane, University of Minnesota, will have a bench-scale N₂ gas High Expansion Foam Technology (HEFT) unit present to provide demonstration participants with an introduction to the HEFT technology. Dr. Zac Williams, University of Arkansas, will demonstrate carcass management through carcass grinding. The ground carcass material will be loaded into a Supreme International, Ltd. vertical tub mixer wagon, with multiple carbon blends, to develop different types of compost mix. The various compost mixtures will then be placed into compost windrows.

On Days 1 and 2, Dr. Elizabeth Strand will introduce the American Association for Swine Veterinarians (AASV) *Animal Depopulation Resiliency Check-In Tool*¹ (Resiliency Tool, Attachment 3). The tool is designed for people directly or indirectly exposed to animal depopulation. The tool provides a self-administered questionnaire for people to monitor the changing effects of experiencing animal depopulation. The tool is intended to identify when the effect of experiencing a depopulation event may warrant the support or intervention of mental health professionals.

¹ The AASV Resiliency Tool can be found at https://aasv.org/Resources/welfare/depopulation_debrief.pdf

Participant/Observer Guidelines

- All participant parking will be at the *MSU Pavilion for Agriculture and Livestock Education*, 4301 Farm Lane, Lansing, MI, both days. Transportation to field demonstration sites will be provided by MSU. Personal vehicles are not allowed at the field demonstration locations.
- Participants must sign in every day and wear the color-coded vest designated for their role in the exercise. At sign-in, Observers will be assigned to one of three groups for the demonstration activities.
- Observers will be issued **green** observer vests. Exercise staff will wear **blue** vests. Technology demonstrators will wear **red** vests. These vests must be worn throughout the demonstration.
- Only participants who have submitted a signed waiver and Nondisclosure Agreement (NDA) will be allowed to participate in the demonstration activities. (Attachment 1).
- Remember to check the weather and dress appropriately.
- Observers must stay in designated Observer areas and follow the instructions of their group leaders and all exercise staff. Failure to do so may result in the Observer being asked to leave.
- Observers must follow the safety protocols for this demonstration and abide by any direction provided by the safety officer(s). Failure to follow the demonstration safety guidance will result in participants being expelled from the demonstration. A safety plan for Observers is presented in Attachment 2.
- No pictures or recordings are allowed while at the exercise site; only select exercise staff have been authorized to take pictures and record videos. These personnel will be identified on Day 1.

Demonstration Schedule²

	Time	Activity	Location
Monday, October 23, 2023	12:30 p.m.	Registration/Check-in	MSU Pavilion Auditorium / Classroom CD
	1:00 p.m.	Introduction / Welcome	
	1:30 p.m.	Review of related NPB and other research	
	2:10 p.m.	Break	
	2:20 p.m.	Presentations on four depopulation strategies	
	3:20 p.m.	Presentation on the AASV resiliency tool / Intro and overview	
	3:35 p.m.	Break	
	3:45 p.m.	Overview of the demonstration schedule and safety briefing	
	4:15 p.m.	Break/Bus transportation to equipment area	Travel to MSU South Farms
	4:30 p.m.	Equipment viewing or presentation on the AASV resiliency tool AASV presentation times: 4:40 p.m. 5:05 p.m. 5:30 p.m.	MSU South Farms Service Center
	6:00 p.m.	Dinner service / Networking	MSU Pavilion Auditorium / Classroom CD
	7 p.m.	Meeting adjourns for evening	MSU Pavilion Auditorium / Classroom CD
Tuesday, October 24, 2023	6:30 - 7:30 a.m.	Check-in and bus transportation to equipment area	MSU Pavilion
	7:45 a.m.	Breakfast and check-in Welcome/intro/safety brief	MSU South Farms Service Center Shop
	8:15 a.m.	Start Nitrogen demonstration	Group A
	8:20 a.m.	Start H ₂ O demonstration	Group B
	8:25 a.m.	Start CO ₂ demonstration	Group C
	8:40 a.m.	Board buses for compost area or stay for Dr. Strand presentation	
	8:55 a.m.	View compost area / Dr. Strand presentation	
	9:40 a.m.	Board buses for depopulation demonstration area	
	10:05 a.m.	Start Nitrogen demonstration	Group B
	10:10 a.m.	Start H ₂ O demonstration	Group C
	10:15 a.m.	Start CO ₂ demonstration	Group A
	10:30 a.m.	Board buses for compost area or stay for Dr. Strand presentation	
	10:45 a.m.	View compost area / Dr. Strand presentation	
	11:15 a.m.	Board buses for depopulation demonstration area	
	11:35 a.m.	Start Nitrogen demonstration	Group C
	11:40 a.m.	Start H ₂ O demonstration	Group A
	11:45 a.m.	Start CO ₂ demonstration	Group B
	12:00 p.m.	Wrap up Discussion and Lunch	MSU South Farms Service Center Shop
1:30 p.m.	Program concludes return to MSU Pavilion via bus		

² Maps of the demonstration sites are presented in Attachment 4.

Key Demonstration Contacts

Exercise Role	Contact
Demonstration Director	Dr. Dale Rozeboom, MSU
Demonstration Director	Ms. Stephanie Wisdom, NPB
Assistant Demonstration Director	Dr. Madonna Benjamin, MSU
MSU Safety Officer	Mr. Tony Boughton, MSU
Participant and Lodging Coordinator	Ms. Sarah Catharine Arthur, NPB
Logistics Coordinator	Ms. Megghan Honke-Seidel, MSU
Assistant Logistics Coordinator	Ms. Oliva Walker, MSU
Observer Group Management	Mr. Bryan Deimeke, SES, 573-721-0055
Observer Group Management	Ms. Megan Eastman, SES, 641-425-6383
Observer Group Management	Mr. Eric Hess, SES, 913-530-2989
Observer Group Management	Ms. Lindsey Mott, SES, 417-718-8368
AASV Resiliency Tool	Dr. Elizabeth Strand, UT
CO ₂ Gas Depopulation	Ms. Lucia Hunt, MDA
N ₂ -Filled Foam Depopulation	Mr. Jeff Hill, AES
Water-Based Foam Depopulation	Dr. Andrew Bowman, OSU
N ₂ Gas-HEFT Depopulation	Dr. Marie Culhane, UMN

Demonstration Communication Plan

The primary mechanism for exercise conduct communication and emergency communication will be through handheld radios supplied by MSU. These radios will be provided to the exercise participants listed below. In addition, the cellular telephone numbers for all SES personnel are listed above as a secondary communication method³.

Dr. Rozeboom (Exercise Director)
 Ms. Stephanie Wisdom (Exercise Director)
 Dr. Madonna Benjamin (Assistant Exercise Director)
 Animal loading manager (TBD)
 Bus driver 1 (TBD)
 Bus driver 2 (TBD)
 Bus driver 3 (TBD)
 Mr. Tony Boughton, MSU Safety Officer
 Mr. Eric Hess (Group Manager)

Ms. Meghan-Honke Seidel (Logistics Coordinator)
 Ms. Marguerite Tan (NPB)
 Mr. Jeff Hill (N₂-gas filled foam)
 Ms. Lucia Hunt (CO₂ gas)
 Dr. Andrew Bowman (water-based foam)
 Dr. Elizabeth Strand (AASV Resiliency Tool)
 Ms. Megan Eastman (Group Manager)
 Mr. Bryan Deimeke (Group Manager)
 Ms. Lindsey Mott (Group Manager)

³ SES staff will have the cellular telephone numbers of the key contacts listed above.

Classroom and Parking Location

The MSU Pavilion for Agriculture and Livestock Education will be the location of Day 1 classroom activities. In addition, all participant parking for Days 1 and 2 will be in the pavilion parking lot (Figure 1). MSU will provide buses to shuttle participants between the Pavilion and field demonstration locations. The address for the Pavilion is: 4301 Farm Lane, Lansing, MI.

Figure 1: MSU Livestock Pavilion – Classroom and Parking Locations



Attachment 1: MSU Waiver and NPB NDA

MICHIGAN STATE UNIVERSITY NATIONAL PORK BOARD (NPB) AND MICHIGAN DEPOPULATION DEMONSTRATION FIELD DAY ASSUMPTION OF RISK, WAIVER AND RELEASE OF LIABILITY AGREEMENT

Michigan State University ("MSU") will host the National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day. The Depopulation Training includes, but is not limited to, handling animals, and using animal handling and euthanasia equipment, climbing scaffolding to view trailers and being in the vicinity of gases and foams used for euthanasia. In consideration of your participation in the National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day, you agree as follows:

1. **ASSUMPTION OF RISK.** You understand and acknowledge that National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day involves risk, including but not limited to, risk of death, serious bodily injury, and property damage. These risks may result from the training itself, from the acts of others or animals, or from the unavailability of emergency medical care. You acknowledge and agree that you are voluntarily assuming all the risks that may arise out of your participation in the National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day. You acknowledge that participation in the National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day is voluntary, and you may withdraw at any time.
2. **INSTRUCTIONS, POLICIES, AND PROCEDURES.** At all times during participation in National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day, you agree to fully observe and implement all instruction provided by any employee or representative of MSU with respect to safety procedures and with respect to your conduct and actions while participating in the National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day Training. MSU staff and representatives reserve the right to revoke your permission to participate in National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day and request that you to leave immediately for any violations of the rules of MSU, including rules related to your conduct during National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day.
3. **SUPERVISION OF MINORS.** You understand that minors are required to be supervised by a parent, guardian, or other adult at all times.
4. **WAIVER AND RELEASE.** To the fullest extent permitted by law, you hereby release, waive, and discharge Michigan State University, its Board of Trustees, officers, employees, agents, students, or volunteers from any and all claims, actions, causes of action, suits, liability, losses, demands, damages, expenses, fees, and costs for any property damage, property loss or theft, personal injury, death or other loss arising from or relating to your participation in National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day. You release and discharge Michigan State University from any claim that arises or may arise due to any first aid, medical treatment, or service rendered to you.
5. **CHOICE OF LAW; JURISDICTION.** This agreement shall be governed in all respects by the laws of the State of Michigan. The Michigan Court of Claims or Federal District Court for the Western District of Michigan will hear any action arising out of this agreement, and you consent to jurisdiction in the State of Michigan.
6. **SEVERABILITY.** You expressly agree that the foregoing agreement is intended to be as broad and inclusive as permitted by Michigan law and that if any portion thereof is held to be invalid, the remainder of the agreement shall continue in full legal force and effect.

You acknowledge that you have read the foregoing and that you are aware of the legal consequences of this agreement, including that it releases Michigan State University from claims you may have if you are injured, or your property is damaged as a result of your participation in National Pork Board (NPB) and Michigan Depopulation Demonstration Field Day.

Signature: _____

Printed Name: _____

Date: _____

Confidentiality Agreement

This Confidentiality Agreement (this "Agreement") is entered into as of _____, (the "Effective Date") by and between the National Pork Board, a governmental entity with offices at 1776 NW 114th Street, Clive, IA 50325 ("NPB"), and _____, with offices at _____ ("Participant"). Participant and NPB are collectively referred to as the "Parties," and each individually as a "Party."

For good and valuable consideration, the adequacy and receipt of which is acknowledged by each Party:

- 1. Confidential Information.** Participant acknowledges that, as an invitee to NPB's event Michigan State University Demonstration and Mortality Management Event (the "Event") which will be held on October 23-24, 2023, it will have access to confidential information, including the fact that the Event is taking place.
- 2. Use of Confidential Information.** Participant agrees to keep strictly confidential all information about the Event and its participants and is strictly prohibited from taking photographs or video or audio recording at the Event. Participant will refrain from any disclosure or use of confidential information unless permitted under this Agreement.
- 3. Duration of Obligations; Degree of Care; Access by Employees.** Participant must keep their participation in the event confidential until after the event occurs. Any information learned by participant at the event is not restricted from use, so long as Participant uses the same degree of care to avoid the unauthorized disclosure, dissemination, or use of the information as Participant uses to protect its own sensitive or confidential information, but in no case less than reasonable care. Participant shall restrict the possession, knowledge and use of information learned at the Event to the directors, officers, employees, agents and advisors to Participant and its Affiliates (collectively, "Representatives") who have a need to know such information.
- 4. Required Disclosures.** Recipient may disclose information about the Event as required to comply with a valid and effective subpoena or order of a governmental entity or court with proper jurisdiction or as otherwise required by applicable laws, rules or regulations, provided that Recipient (A) gives NPB prompt written notice to allow NPB to seek a protective order or other appropriate remedy (except to the extent Participant's compliance with the foregoing would cause it to violate a court order or other legal requirement), (B) discloses only such information as is required by the order or other legal requirement, and (C) uses reasonable efforts to obtain confidential treatment of the information so disclosed.
- 5. Injunctive Relief.** Recipient acknowledges that disclosure or use of Confidential Information of Discloser in violation of this Agreement will cause irreparable harm to NPB for which monetary damages would be an inadequate remedy and difficult to ascertain. Participant therefore agrees that NPB shall have the right, in addition to any other rights and remedies, to obtain injunctive relief for any violation of this Agreement by Participant with no requirement to post any applicable bond and without further proof of irreparable harm.

This Confidentiality Agreement is executed by Participant of the Effective Date.

Participant Name

Signature: _____

Name: _____

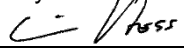
Title: _____

Attachment 2: Observer Safety Plan

INCIDENT ACTION PLAN SAFETY ANALYSIS (ICS 215A)

1. Incident Name: NPB-MSU Depopulation Training and Demonstration		2. Incident Number: Not Applicable	
3. Date/Time Prepared: Date: _____ Time: _____		4. Operational Period: Date From: 10/23/23 Date To: 10/24/23 Time From: 1230 Time To: 1300	
5. Incident Area	6. Hazards/Risks	7. Mitigations	
Classroom presentations	Presentations will be at the MSU livestock pavilion. There is the potential for live animals (livestock) to be present at the pavilion. While the classroom presentations will be away from the animal handling/housing areas, approaching or encountering livestock can result in personal injury (e.g., falls, trampling, bites, etc.).	Classroom participants will move directly from the parking lot to the demonstration classroom. If livestock are encountered during this movement, participants will cease movement until the livestock have been moved out of the way, so contact is not possible. Classroom participants will not enter any animal living or handling areas in the pavilion.	
Live animal handling	This demonstration will involve live swine of varying sizes. Trained animal handlers will move and load animals into the demonstration technologies. There is a risk that live animals will escape. Approaching or encountering live swine can result in personal injury (e.g., falls, trampling, bites, etc.).	If animals escape, participants will not attempt to assist animal handlers in capturing the loose animals, or otherwise approach loose animals. Participants will abide by the directions given by the animal handlers, to avoid contact with the loose swine.	
Nitrogen Foaming and CO ₂ gas demonstration	While the depopulation systems are in use, excessive noise may be produced (>85 decibels [dB]). Some of the technologies may exceed the 105 dB, the OSHA 1-hour/day exposure limit.	SES will monitor sound levels generated by the demonstrated technologies. Any participant in an area that is exposed to 85 dB or more of sound will wear hearing protection. Foam ear plugs will block at least 20 dB of sound (noise reduction rating [NRR]). Foam ear plugs will be used in areas where sound levels are between 85 and 100 dB. Observers/workers in areas exceeding 100 dB of sound will wear over-the-ear muffs with a NRR of at least 23dB and foam ear plugs.	

5. Incident Area	6. Hazards/Risks	7. Mitigations
CO ₂ gas depopulation area and carcass dumping from the CO ₂ gas system	CO ₂ gas is heavier than air. This gas is an asphyxiant, and at concentrations above 40,000 parts per million (ppm) can replace oxygen in blood, creating an Immediately Dangerous to Life and Health (IDLH) environment. At lower concentrations it can cause headaches, dizziness, difficulty breathing, and tremors. When CO ₂ gas is pumped into the depopulation container, there is a chance some gas will leak out of the system, into the environment. Prior to dumping carcasses out of the gas chamber, the CO ₂ will be released. When dumping or due to leakage, the gas will disperse due to turbulent or laminar mixing. Turbulent mixing will rapidly disperse the gas, dropping its concentration below hazardous thresholds. Laminar mixing will not result in rapid dispersion of the gas and will allow the gas to accumulate in low lying areas or depressions. In these cases, the low-lying areas or depressions could build up CO ₂ concentrations that would be hazardous to human health. The transition from laminar to turbulent air flow is at approximately 3 miles per hour (2015, <i>Dependence of Turbulent Velocities on Wind Speed and Stratification</i> , L.Mahrt, et.al, <i>Boundary Layer Meteorology</i> 155, 55-71).	<p>Demonstration participants will avoid any low areas or depressions within 100 feet of a CO₂ gas source or container that are deeper than their waist, relative to the normal grade of the area. If wind speeds exceed 10 miles per hour, this restriction will be lifted.</p> <p>Wherever possible, CO₂ gas monitors or oxygen level meters will be used to monitor the ambient gas levels in the workspace. Work will be stopped, and workers evacuated, in any area with a CO₂ concentration above 5,000 ppm.</p>
Nitrogen-filled foam and water-based foam depopulation area and carcass dumping from foam systems	The foam used for depopulation of livestock works by asphyxiation. This happens when the animals are submerged in the foam. When foam is generated, there is the potential for some amounts to be spilled into the general work environment. When carcasses are dumped for disposal, they will be covered with foam. Any participants entering an area where there is uncontained foam will be exposed to slip, trip, and fall hazards. Falling into this foam could result in asphyxiation and death, even in foam depths of inches.	<p>Participants should not contact uncontained foam during this demonstration. If this becomes necessary, any participants entering uncontained foam must use a buddy system for accountability; in addition, a third person will be staged outside the foam area to monitor the status of participants in the foam.</p> <p>Prior to entering foam, participants should use a portable leaf-blower to clear the foam, or other mechanism to disperse or dissipate the foam.</p> <p>If both participants in the foam go down, the observer will notify exercise staff who will determine the appropriate course of action, given the supplies and equipment present.</p>
Foam mixing areas	The Phos-Chek foam being used is considered a skin and eye irritant.	Participants handling the foaming concentrates will wear rubber or nitrile gloves and eye protection. Any skin or eye exposures will be immediately treated by flushing with clean water.
Foam container viewing area	Participants will be allowed on elevated structures to view the foam filling on the water-based and nitrogen system. An elevated platform presents a slip, trip, and fall hazard.	Participants on elevated surfaces for viewing the foaming will stay behind safety rails and not lean on the safety rails. One person on a viewing platform will monitor the observers to prevent them from exceeding the protection provided by the safety rails.

5. Incident Area	6. Hazards/Risks	7. Mitigations
Compost area and carcass grinding area	<p>Building compost piles will require the use of heavy equipment to move carcasses and carbon source. Often the visibility for equipment operators is limited, outside their front view. This poses a crush hazard for people around the equipment.</p> <p>Carcass grinding requires the use of heavy equipment to move and load carcasses into the grinder, and to move the grinder output. Often the visibility for equipment operators is limited, outside their front view. This poses a crush hazard for people around the equipment. In addition, the grinder presents a maceration hazard that will result in death.</p>	Participants will be restricted to an observation area outside all heavy equipment operation areas, and outside or not in-line with the grinder-throw safety cone. Depending on the type of grinder, this safety cone can extend up to several hundred feet past the discharge conveyor.
8. Prepared by (Safety Officer): Name: <u>Eric Hess</u> Signature: _____ 		
ICS 215A	Date/Time: September 10, 2023	

ICS 215A Incident Action Plan Safety Analysis

Purpose. The purpose of the Incident Action Plan Safety Analysis (ICS 215A) is to aid the Safety Officer in completing an operational risk assessment to prioritize hazards, safety, and health issues, and to develop appropriate controls. This worksheet addresses communications challenges between planning and operations and is best utilized in the planning phase and for Operations Section briefings.

Preparation. The ICS 215A is typically prepared by the Safety Officer during the incident action planning cycle. When the Operations Section Chief is preparing for the tactics meeting, the Safety Officer collaborates with the Operations Section Chief to complete the Incident Action Plan Safety Analysis. This worksheet is closely linked to the Operational Planning Worksheet (ICS 215). Incident areas or regions are listed along with associated hazards and risks. For those assignments involving risks and hazards, mitigations or controls should be developed to safeguard responders, and appropriate incident personnel should be briefed on the hazards, mitigations, and related measures. Use additional sheets as needed.

Distribution. When the safety analysis is completed, the form is distributed to the Resources Unit to help prepare the Operations Section briefing. All completed original forms must be given to the Documentation Unit.

Notes:

- This worksheet can be made into a wall mount and can be part of the IAP.
- If additional pages are needed, use a blank ICS 215A and repaginate as needed.

Block Number	Block Title	Instructions
1	Incident Name	Enter the name assigned to the incident.
2	Incident Number	Enter the number assigned to the incident.
3	Date/Time Prepared	Enter date (month/day/year) and time (using the 24-hour clock) prepared.
4	Operational Period <ul style="list-style-type: none"> • Date and Time From • Date and Time To 	Enter the start date (month/day/year) and time (24-hour clock) and end date and time for the operational period to which the form applies.
5	Incident Area	Enter the incident areas where personnel or resources are likely to encounter risks. This may be specified as a Branch, Division, or Group.
6	Hazards/Risks	List the types of hazards and/or risks likely to be encountered by personnel or resources at the incident area relevant to the work assignment.
7	Mitigations	List actions taken to reduce risk for each hazard indicated (e.g., specify personal protective equipment or use of a buddy system or escape routes).
8	Prepared by (Safety Officer and Operations Section Chief) <ul style="list-style-type: none"> • Name • Signature • Date/Time 	Enter the name of both the Safety Officer and the Operations Section Chief, who should collaborate on form preparation. Enter date (month/day/year) and time (24-hour clock) reviewed.

Animal Depopulation Resiliency Check-in Tool



Five-Step Resiliency Tool

Directions: These questions can be used 1) individually as a journaling tool, 2) as a discussion guide for “check-in friends,” or 3) as a discussion guide for a daily or weekly team check-in. Participation in the use of this tool should be voluntary. If someone decides to be present but quiet during a team check-in, that is all right. If someone chooses not to participate at all, please ensure they have the 5-step process to do independently as well as information for accessing mental health care.

Question 1: Please share if there is anything you cannot shake right now? What is it? What do you remember about it?

Question 2: Can you think of what you have DONE RIGHT in that situation-even the smallest thing counts (or any recent situation if there was no response to Q1)?

Question 3: Is there anything you wish you had done differently?

Question 4: Is there anything you have learned or need to adjust for tomorrow or next time?

Question 5: Is there anything you feel grateful for or made you laugh in this situation (or in your recent past)?

This is a 5-item resiliency check-in tool that can be used by veterinarians and other animal-related professionals who are preparing for, participating in, and recovering from animal depopulation. These questions have been developed by an experienced veterinary social worker who has been implementing check-ins in the veterinary medical field for 20 years. For animal depopulation use, these questions have been reviewed by 3 doctoral level traumatology experts as well as by several food animal veterinary medical professionals.

This tool is designed to provide credible and attuned social support and self assessment. The use of peer support among professionals experiencing the same stressor has been shown to be an effective tool in protecting mental health.^{1,2} The peer approach is important because it establishes credible social support. Peer support is “credible” because the individual offering support has lived experience with the stressor being addressed. Having an outside facilitator or mental health professional use traditional debrief tools (such as critical incident stress debriefing) has demonstrated iatrogenic effects.^{3,4} Peer support can provide an alternative way to protect the mental health of professionals exposed to traumatic stress.¹

Although credibility is important, that alone can also create iatrogenic effects if the peer connection only includes reliving a trauma, simple complaining about the experience, or a “pull yourself up by your bootstraps” type of advice giving support. To help the social support avoid iatrogenesis, these questions are designed to guide animal professionals through a specific 5-step socio-emotionally attuned traumatic growth process. Attunement means that the process invites professionals to share their experience in such a way that helps connect them with their own and others authentic experience and positive coping in managing animal depopulation. The steps are predictable, replicable, and can be implemented by animal-related professionals themselves. The use of lay person public health approaches to help individuals facing a mental health challenge recognize it and get support accessing help is a growing approach to meet mental health needs.⁵

Following is a description of each question in the 5-step process including the keywords and rationale behind the use of the question.

Question #1 (keywords: intrusive thoughts, rumination, and social support)

Q1 Please share if there is anything you cannot shake right now? What is it? What do you remember about it?

Rationale: This question invites individuals to put into words any experience that is causing intrusive thoughts and rumination. Intrusive thoughts are unwanted images or memories of a stressful event. Rumination is the circular repetition of these unpleasant thoughts. These are typical experiences when someone is experiencing traumatic stress. An important skill in managing this is to “name” what the event is and connect that to emotions that occur in relation to the event. If answered in a dyad or group, this “storytelling” allows others to normalize the experience and feel more comfortable sharing their own experiences. Importantly, this question invites someone to share, but does not assume they had such an experience or want to share it. Individuals may or may not have an answer to this question and may or may not wish to answer it publicly. It is essential to respect an individual’s self-determination on what and if to share answers to this question.

Question #2 (keywords: coping and self-efficacy)

Q2 Can you think of what you have DONE RIGHT in that situation-even the smallest thing counts (or any recent situation if there was no response to Q1)?

Rationale: When someone is going through a stressful event, once it is acknowledged by Q1, inviting them to focus on how they are coping well is important. This question helps the individual recognize the ways in which they are demonstrating self-efficacy and positive intention in the midst of a difficult circumstance. Research indicates that attending to evidence of positive personal behaviors is helpful even if one thinks of a circumstance NOT related to the current stressor (as would be the case if there was no answer to Q1).⁶

Questions #3 and #4 (keywords: coping, self-efficacy, and problem-solving)

Q3 Is there anything you wish you had done differently?

Q4 Is there anything you have learned or need to adjust for tomorrow or next time?

Animal Depopulation Resiliency Check-in Tool

Rationale: When individuals can learn from their stressful experiences it promotes a sense of empowerment and self-efficacy. These questions also help a person engage active problem solving to avoid being simply overwhelmed by the stressor. They help individuals use their experience to change strategies and keep growing as an animal professional. Moreover these questions invite practical problem-solving so that the individual may be more successful when they face the situation again.

Question #5 (keywords: gratitude, humor, and professional identity)

Q5 Is there anything you feel grateful for or made you laugh in this situation (or in your recent past)?

Rationale: Research in the field of positive psychology has demonstrated that attending to gratitude can have a positive impact on mental health.⁷ Moreover, gratitude is also present for those with higher resiliency from traumatic stress.^{8,9} Although the use of humor in times of tragedy is very dependent on individual preferences and traits, there is some evidence that it helps in cultivating an authentic professional identity.¹⁰ This question allows professionals to choose which type of positive emotion to connect with that will be most personally helpful.

How to use the tool

Individually: This tool can be used individually by anyone who seeks to monitor their well-being throughout a depopulation experience. To do this, an individual can use this as a writing prompt tool. Writing as a way to mitigate traumatic stress and promote post traumatic growth is evidenced in the research literature.¹¹⁻¹³

Dyadically: This tool can be used as part of a dyadic “check-in friend” system that an individual sets up in preparation for a depopulation event. The “check-in friend” dyad would meet periodically, in person, by phone, or on a web meeting, and answer the questions together and share responses as a way to establish credible socio-emotionally attuned support before, during, and after the depopulation event. The dyad can determine the frequency based on their own schedules and availability.

As a team: This tool can be used as a daily or weekly team check-in to establish and prioritize credible and socio-emotionally attuned support. Each member can be encouraged but not required to attend. If in

attendance, each member can share or not share. Each person should be allotted about 7 minutes to share responses to the questions. It would be helpful to print out the tool and have copies on hand.

Additional considerations

If someone is consistently unable to identify and connect with positive feelings at the end of the 5-step process, it would be appropriate to encourage that individual to seek specialized mental health support from a licensed professional. It is important to respect self-determination of the individual who may or may not choose to seek such specialized support. These types of specialized mental health support resources can be offered but not required. Although the presence of positive feelings does not indicate the absence of psychological distress,⁷ the presence of positive feelings does correlate with more resilience.^{8,9} Therefore the prolonged absence of positive feelings would be an appropriate indicator that additional support could be helpful.

Moreover, all individuals who are participating in depopulation should be informed of the mental health resources that are available to them. Alerting animal professionals of these resources in regular intervals before, during, and after the depopulation would be appropriate.

Lastly there are mental health screeners that individuals can complete to help them monitor their psychological distress privately. For example these screeners from Mental Health America: [screening.mhanational.org/screening-tools/](https://www.mhanational.org/screening-tools/)

Preparation

- 1) Locate employee behavioral health insurance benefits
- 2) Determine if company/farm has an Employee Assistance Program and what benefits are available
- 3) Provide mental health care information in advance
 - a) Include free resources such as
 - i) screening.mhanational.org/screening-tools/
 - ii) suicidepreventionlifeline.org/ or call 988
 - iii) samhsa.gov/find-help/disaster-distress-helpline
- 4) Normalize consulting with mental health care as a part of sound self-care during depopulation

Citation: Elizabeth B. Strand, PhD, LCSW; Director, Veterinary Social Work, University of Tennessee, Knoxville; Colleges of Veterinary Medicine and Social Work; Tel: 865-755-9948; Email: estrand@utk.edu. In collaboration with the American Association of Swine Veterinarians. Development of this resource was funded by USDA's Animal and Plant Health Inspection Service through the National Animal Disease Preparedness and Response Program.

References

1. Low, R., King, S. & Foster-Boucher, C. Learning to Bounce Back: A Scoping Review About Resiliency Education. *J. Nurs. Educ.* 58, 321–329 (2019).
2. Lane, M. A. et al. Supporting Clinicians After Adverse Events: Development of a Clinician Peer Support Program. *J. Patient Saf.* 14, e56–e60 (2018).
3. Regel, S. Post-trauma support in the workplace: the current status and practice of critical incident stress management (CISM) and psychological debriefing (PD) within organizations in the UK. *Occup. Med.* 57, 411–416 (2007).
4. Critical Incident Stress Debriefing: Helpful, Harmful, or Neither? *Journal of emergency nursing: JEN: official publication of the Emergency Department Nurses Association* vol. 45 611–612 (2019).
5. Synowski, J., Weiss, H. A., Velleman, R., Patel, V. & Nadkarni, A. A lay-counselor delivered brief psychological treatment for men with comorbid Alcohol Use Disorder and depression in primary care: Secondary analysis of data from a randomized controlled trial. *Drug Alcohol Depend.* 227, 108961 (2021).
6. Creswell, J. D. et al. Affirmation of personal values buffers neuroendocrine and psychological stress responses. *Psychol. Sci.* 16, 846–851 (2005).
7. Jans-Beken, L. et al. Gratitude and health: An updated review. *J. Posit. Psychol.* 15, 743–782 (2020).
8. Zhou, X. & Wu, X. Longitudinal relationships between gratitude, deliberate rumination, and posttraumatic growth in adolescents following the Wenchuan earthquake in China. *Scand. J. Psychol.* 56, 567–572 (2015).
9. Israel-Cohen, Y., Uzevovsky, F., Kashy-Rosenbaum, G. & Kaplan, O. Gratitude and PTSD symptoms among Israeli youth exposed to missile attacks: examining the mediation of positive and negative affect and life satisfaction. *J. Posit. Psychol.* 10, 99–106 (2015).
10. Cain, C. L. Integrating Dark Humor and Compassion: Identities and Presentations of Self in the Front and Back Regions of Hospice. *J. Contemp. Ethnogr.* 41, 668–694 (2012).
11. Krupnick, J. L. et al. An Internet-based writing intervention for PTSD in veterans: A feasibility and pilot effectiveness trial. *Psychol. Trauma* 9, 461–470 (2017).
12. Canada, K. E., Brinkley, A., Peters, C. & Albright, D. L. Military veterans: Therapeutic journaling in a veterans treatment court. *Journal of Poetry Therapy* 28, 113–128 (2015).
13. Ullrich, P. M. & Lutgendorf, S. K. Journaling about stressful events: effects of cognitive processing and emotional expression. *Ann. Behav. Med.* 24, 244–250 (2002)

Animal Depopulation Resiliency Check-in Tool Worksheet



This five-question resiliency check-in tool can be used by veterinarians and other animal-related professionals who are preparing for, participating in, and recovering from an animal depopulation event. This tool is designed to provide credible and attuned social support and self-assessment.

How to use the tool

Individually: This tool can be used individually by anyone who seeks to monitor his or her wellbeing throughout a depopulation experience. To do this, an individual can use this as a writing prompt tool to mitigate traumatic stress and promote post traumatic growth.

Dyadically: This tool can be used as part of a dyadic “check-in friend” system that a professional sets up in preparation for a depopulation event. The “check-in friend” dyad would meet periodically, in person, by phone, or on a web meeting, and answer the questions together and share responses as a way

to establish credible socio-emotionally attuned support before, during, and after the depopulation event. The dyad can determine the frequency based on their own schedules and availability.

As a team: This tool can be used as a daily or weekly team check-in to establish and prioritize credible and socio-emotionally attuned support. Each member can be encouraged but not required to attend. If in attendance, each member can share or not share. Each person should be allotted about 7 minutes to share responses to the questions. It would be helpful to print out the tool and have copies on hand.

- 1. Please share if there is anything you cannot shake right now? What is it? What do you remember about it?**

- 2. Can you think of what you have DONE RIGHT in that situation-even the smallest thing counts (or any recent situation if there was no response to Q1)?**

- 3. Is there anything you wish you had done differently?**

- 4. Is there anything you have learned or need to adjust for tomorrow or next time?**

- 5. Is there anything you feel grateful for or made you laugh in this situation (or in your recent past)?**

If someone is consistently unable to identify and connect with positive feelings at the end of the 5-step process, it would be appropriate to encourage them to seek specialized mental health support from a licensed professional. It is important to respect self-determination of the individual who may or may not choose to seek such specialized support. These types of specialized mental health support resources can be offered but not required. While the presence of positive feelings does not indicate the absence of psychological distress, the prolonged absence of positive feelings would be an appropriate indicator that additional support could be helpful.

All individuals who are participating in depopulation should be aware of the mental health resources that are available to them.

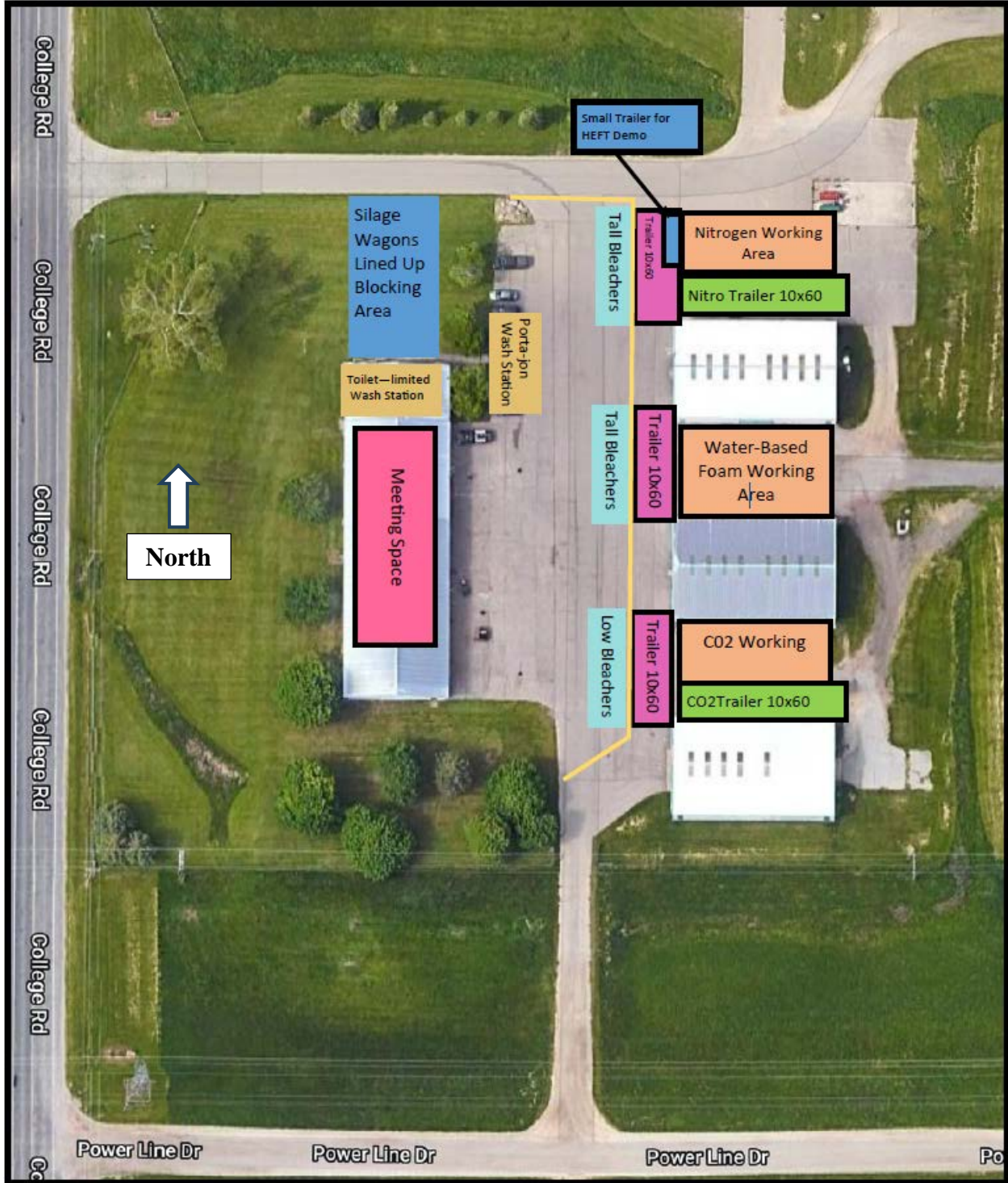
- Does your employer have behavioral health insurance benefits?
- Does your employer have an Employee Assistance Program?
- Free screening and referral resources available include:
 - ◆ screening.mhanational.org/screening-tools
 - ◆ suicidepreventionlifeline.org or call 988
 - ◆ samhsa.gov/find-help/disaster-distress-helpline

Mental health care, including consulting with mental health care professionals, is a part of sound self-care during and after a depopulation event.

Citation: Elizabeth B. Strand, PhD, LCSW; Director, Veterinary Social Work, University of Tennessee, Knoxville; Colleges of Veterinary Medicine and Social Work; Tel: 865-755-9948; Email: estrand@utk.edu. In collaboration with the American Association of Swine Veterinarians. Development of this resource was funded by USDA's Animal and Plant Health Inspection Service through the National Animal Disease Preparedness and Response Program.

Attachment 4: Demonstration Site Maps

Field Demonstration Layout – University Farm Service Center



Michigan State University and National Pork Board Depopulation Demonstration Field Day Compost Area



Best Practices for

Water-based Foam Depopulation

Use & Operation for Swine

FINAL VERSION 8/11/2023

Purpose

Depopulation of swine can be effectively accomplished using a water-based foam (WBF) delivery system. Recent studies have shown this method to be humane and effective in controlled experiments and has been successfully used in field research. It is currently under investigation by several institutions for scientific validation. Depopulation in this manner improves animal welfare and the mental health of veterinarians and farm workers by eliminating the need for individual animal handling and restraint. Private, state, and federal resources exist in Ohio to accomplish depopulation needs on a mass scale. Depopulation (“Depop”) trailer modifications and equipment specifications are detailed in a build manual, this document contains the best practices on how to use them effectively.

Personnel Needed

Process/Confirmation of Death Manager (1-2): Manages application and timing of WBF to occupied depop trailer. Is aware of safety issues with the equipment and ensures compliance of all staff with safety protocols and equipment. Records application times, ensures insensibility and lack of movement indicating death on animals exposed to WBF, communicates frequently with WBF Manager. Recommend DVM or experienced animal welfare specialist for the position; must be experienced with WBF system.

Animal Movement Handlers (4): Coordinates movement of live animals from the barn, transport, or holding pen and ensures they are safely loaded onto the depop trailer. Operates interior cut gate, loading ramp and rails, and closure of loading door when loading is complete. Recommend experienced animal handlers or farm staff. Consider personnel from other facilities to allay mental health concerns.

WBF Production Manager/Team (3): Manages foam application, water-foam concentrate preparation, and connection of lines between holding tanks, water pumps, and foam nozzles. Ensures sufficient levels of water-foam concentrate solution are available prior to applying WBF to depop trailer. Able to troubleshoot issues that prevent the production of foam.

Driver (1): Operates tractor cab connected to dedicated depopulation trailer. Positions trailer for loading, moves trailer from application to disposal site, operates hydraulic end-dump, ensures tractor-trailer is properly cleaned and decontaminated as necessary.

Dependent on scope of the depopulation operation, additional personnel may be needed to rotate in for relief breaks.

Equipment Needed

A complete water-based foam depopulation system consists of 3 components:

Depopulation (“Depop”) Trailer (1-2): a 40’ dump trailer that has been modified with a sliding door for loading, a midpoint cut gate to contain animals, and a ceiling with safety rails and access ladders.

Tractor Cab (1-2): a semi equipped with a single wet line, auxiliary lighting hook-up, and hydraulic pack to raise and lower the depop trailer. A second dump trailer may be used in tandem to alternate loads.

Water-Based Foam Delivery System: 2” high pressure water pump with fire hose adapter and pressure relief valve (3), 1.5”x 50’ fire hose (3-6), 2” round hose strainer (3), 2” x 20’ PVC suction hose assembly (3), medium expansion foam nozzle (3), 300 gallon water holding tank (3), garden hoses, 10’ ropes (3), Class A foam concentrate (Phos-Chek® WD881 or equivalent).

Trailer Setup/Route Layout

The Depop trailer should be backed up directly to the barn's loading door, transport trailer, or loading chute. After loading, the trailer may be moved to a secondary position to apply WBF. Once the resting period is over, the trailer will move to the Mortality Disposal Area to empty and return to the loading area.

Water-Based Foam Set-Up Procedure

This procedure is based off operation of the current Manual for a Water-Based Foam Depopulation utilizing The Ohio State University’s customized depopulation trailer and WBF delivery set-up. Components and setups may vary and should be operated according to the manufacturer’s recommendations.

The WBF Process Manager oversees these activities:

1. Fill watertight holding tanks with water using garden hoses.
2. Position 2” high pressure water pumps in front of each water tank.
3. Attach 1.5” fire hose adapter to water pump. Tighten.
4. Attach 2” round hose strainer to one end of PVC suction hose.
 - a. If holding tank has a drain outlet, connect PVC suction hose directly to the outlet.
5. Attach free end of PVC suction hose to water pump.
6. Roll out fire hose, remove any kinks.
7. Attach fire hose to fire hose adapter on water pump. Tighten.
8. Attach medium expansion foam nozzle to free end of fire hose. Tighten.
9. Tie 10’ ropes to foam nozzles with a safety knot.
10. Attach pressure relief valve to water pump. Tighten.
11. Attach garden hose to pressure relief valve.
12. Mix 1% ratio of foam concentrate into the full water tank. Add 1 gallon concentrate for every 100 gallons of water in the holding tank. Stir to mix well.

Safety Consideration: Eye protection must be worn while handling foam concentrate to include measuring, pouring, and mixing.

13. Lower round hose filter into prepared foam concentrate-water solution.
 - a. Skip this step if the PVC hose is connected to the water tank drain outlet.
14. Check equipment by priming and starting pump and verifying foam production, and proper foam volume and density. Foam should stand with form, not puddle.

Safety Consideration: In order to avoid injury and damage to equipment, utilize proper tools when assembling foaming equipment.

Loading

1. Driver will:
 - a. Ensure the depop trailer is properly positioned to receive animals.
 - b. Ensure that air brakes are engaged on the vehicle and tail gate is closed and locked.
 - c. Ensure ceiling tarp is retracted.
2. Process Manager will:
 - a. Ensure truck is prepared for animal loading.
 - b. Ensure WBF delivery system is fully assembled and functional.
3. Animal Movement Handlers will:
 - a. Prepare the depopulation trailer to receive pigs.
 - b. Ensure cut gate is locked in place and door is open.
 - c. Open loading door.
 - d. Lower loading ramp and assemble safety rails.
 - e. Load pigs into front half of depop trailer.

Safety Consideration: Experienced animal handlers are recommended to avoid injury to unskilled personnel.

- f. CLOSE the cut gate door.
- a. Load pigs into back half of depop trailer.
 - i. Space allowance per animal will follow TQA recommendations (i.e. ~8-9 sq. ft. per sow or up to 30 sows per cycle)

Safety Consideration: Use of driving aids such as pig boards are encouraged to ease loading and avoid injury to handlers.

- b. Disassemble and close loading ramp.

Safety Consideration: Ensure that all humans are off the trailer before closing the loading ramp.

- c. Close and lock loading door.
- d. Communicate end of loading process to Process Manager

Foam Administration

1. WBF Production Manager/Team will:
 - a. Don safety harnesses.
 - b. Climb safety ladders to the roof of the trailer.
 - i. The first person on top should put up the safety railing and lock it into the brace.
 - c. Hook tethers to the safety line at the bottom of the rail.

Safety Consideration: All personnel on top of the trailer MUST be equipped with a safety harness and tethered to the safety line.

- d. Use ropes to hoist foaming equipment to the top of the trailer.
- e. Manager will ensure team members are ready.
- f. Manager will direct the water pumps to be started.

Safety Consideration: Ear protection should be worn by all personnel in the vicinity of the water pumps to include all team members and any other people who may be present (farm owners, etc.)

- g. Manager will instruct team members to begin foaming.

Safety Consideration: DO NOT LEAN over the edge of the roof to peer inside the trailer AT ANY TIME. Falling into the foam will likely result in DEATH. Falling into a trailer with live animals (without foam) could cause serious injury or death.

Best Practices for CO₂ Depopulation Trailer

Use & Operation for Swine

FINAL VERSION 4/9/2021

Purpose

Depopulation of adult swine can be effectively accomplished using a carbon dioxide trailer system. The AVMA approves this method as acceptable and humane, it has been validated by research, and used successfully in the field. Depopulation in this manner improves animal welfare and the mental health of veterinarians and farm workers by eliminating the need for individual animal handling and restraint. Private, state, and federal resources exist in Minnesota to accomplish depopulation needs on a mass scale. Depopulation (“Depop”) trailer modifications and specs are detailed in a build manual, this document contains the best practices on how to use them effectively.

Personnel Needed

Process Manager (1-2 people can operate up to 4 trailers): Manages application and timing of CO₂ to occupied depop trailer. Is aware of safety issues with the equipment and ensures compliance of all staff with safety protocols and equipment. Connects CO₂ lines to depop trailer, administers CO₂ and records application times, communicates frequently with CO₂ Manager. Recommend DVM for the position.

Animal Movement Handler (4): Ensures that live animals are safely loaded from the barn, transport, or holding pen onto the depop trailer. Operates interior gate and closure of loading door when loading is complete. Recommend experienced animal handlers from other facilities to allay mental health concerns.

Confirmation of Death Manager (1): Ensures insensibility and lack of movement indicating death on animals exposed to CO₂. Recommend DVM or experienced animal welfare specialist for the position.

CO₂ Production Manager (1-2): Manages delivery, loading, and connection of lines between liquid CO₂ tanks, vaporizer, and holding tanks. Ensures sufficient levels of CO₂ are available prior to opening the inlet valve to depop trailer. Able to troubleshoot issues that prevent the constant flow of CO₂.

Other (1): A driver of a tractor cab outfitted with a wet kit is dedicated to each depopulation trailer and moving it from the loading/application area to the disposal site. Farm staff authorized to be inside the barn may be responsible for moving animals from pens to the loading chute.

Dependent on scope of the depopulation operation, additional personnel may be needed to rotate in for relief breaks.

Equipment Needed

A complete CO₂ depopulation trailer system consists of 3 components:

Depopulation (“Depop”) Trailer (1-2): a 40’ dump trailer that has been modified with a sliding door for loading, a midpoint gate to contain animals, a ceiling, and plumbing to deliver CO2. This unit is transported by a semi equipped with a wet pack to raise and lower the depop trailer. A second dump trailer may be used in tandem to alternate loads.

Vaporizer Trailer (1): Contains liquid CO2 tanks and a vaporizer unit to expand liquid CO2 to ambient temperature vapor. Heated in cold weather. This enclosed trailer is pulled by a pickup truck.

Holding Tank Trailer (2): Carries 2-4 securely attached low pressure holding tanks. This flatbed trailer is pulled by a pickup truck.

Trailer Setup/Route Layout

The Depop trailer should be backed up directly to the barn's loading door, transport trailer, or loading chute. After loading, the trailer may be moved to a secondary position to apply CO2. Once the resting period is over, the trailer will move to the Mortality Disposal Area to empty and return to the loading area.

The Vaporizer Trailer and Holding Tank Trailer must be parked near each other so the CO2 Manager can easily perform all monitoring tasks. Based on the layout of the farm, the pair can be placed near the depop trailer loading area or they can be located outside of the biosecurity line so the loaded depop trailer can park alongside them for CO2 application. If the operation straddles the biosecurity line, care must be taken so that personnel do not cross the line and hoses are properly cleaned and disinfected when leaving the Dirty side.

Liquid CO2 to Vapor CO2 Procedure

This procedure is based off operation of current MDA-owned equipment using a passive 8-fin vaporizer. Components and setups may vary and should be operated per manufacturer’s recommendations.

The CO2 Manager oversees these activities:

1. Connect vaporizer to liquid valve on CO2 cylinder and vapor hose to holding tank(s)
2. Open recirculation valve on CO2 tank
3. Keep valve closed on vaporizer
4. Very slowly open liquid valve on CO2 cylinder to build pressure in vaporizer
5. Do NOT let pressure in vaporizer exceed 100psi
6. Close liquid valve on CO2 cylinder and let sit for several minutes (this will allow any dry ice to sublimate)
7. Open all inlet valves on holding tanks
8. Slowly open both the liquid valve on the CO2 cylinder and the valve on vaporizer at the same time, keeping the pressure in the vaporizer near 100psi.
9. A high-pitched sound should be audible from the vaporizer.
10. Monitor the formation of frost on the fins of the vaporizer. If the frost line gets close to the end of the vaporizer (near the valve/regulator) turn off liquid valve on CO2 cylinder and allow to sit for several minutes.
11. Continue vaporizing CO2 until desired pressure (100-120psi) is reached in the holding tanks.

12. Once holding tanks are filled and depop trailer is loaded, the Process Manager will attach vapor supply lines from holding tanks to low side inlets on depop trailer.
13. Once depop trailer is shut and sealed begin flowing CO2 vapor into depop trailer.
14. At approximately 2 minutes 30 second of CO2 vapor flow, close shut off valves on high side of trailer.
15. Continue to flow CO2 vapor into dump trailer at a consistent rate for the full 5 minutes.
16. When emptying the CO2 vapor storage tanks, DO NOT let the pressure get to ZERO. Leave approximately 5-10 psi in the tank(s). This backpressure is needed for the efficient formation of CO2 vapor during the next cycle.
17. After five minutes, shut off CO2 flow to dump trailer and allow 10 minutes to pass.

***Safety Consideration:** NEVER close inlet valve(s) on holding tank(s) while the liquid CO2 tank valve is open. If CO2 production is complete, turn off liquid CO2 valve first, then allow any residual liquid CO2 in the vaporizer to vaporize. Slowly close inlet valve(s) on holding tank(s). Be sure to watch the pressure gauge on the vaporizer after all valves are closed.*

Cold Weather considerations:

- *Vaporizer trailer must be heated to at least 70°F before the vaporizer unit is put into use*
- *Place a construction heater blowing directly on the vaporizer unit to keep CO2 flow into holding tanks steady*
- *Wrap outdoor plumbing with insulated electric heat tape to keep CO2 from cooling as it flows from the vaporizer to the holding tanks to the depopulation trailer*

Loading

Prior to loading, the CO2 Manager signals sufficient pressure in holding tanks.

1. Process Manager will:
 - Ensure CO2 truck driver is OUT of cab and air locks are LOCKED OUT
 - Ensure CO2 hose is OFF and hooked up to CO2 trailer
 - Ensure Middle Divider Gate is UNLOCKED
2. Animal Movement Handlers will ensure that the CO2 trailer is ready to receive pigs:
 - Ceiling doors are OPEN
 - Divider gate is OPEN
 - Loading gate is OPEN
3. Animal Movement Handlers load pigs into front half of CO2 trailer then CLOSE the divider gate
 - Space allowance per animal will follow TQA recommendations (i.e. ~8-9 sq. ft. per sow or up to 30 sows per cycle)
4. Process Manager readies exterior
 - LOCKS divider gate
 - Install shut off valves and drop pipes on high side of depop trailer
5. Animal Movement Handlers load pigs into back half of CO2 trailer
6. When trailer is full, Animal Movement Handlers:
 - Close back gate
 - Close ceiling doors

- Communicate end of loading process to Process Manager

Safety Consideration: Driver should exit the cab during loading and CO2 administration activities to avoid accidental movement of the unit.

CO2 Administration

Process Manager will initiate Cycle START Process

1. Start timer and record start time
2. Open valve on flex hose to 100% open for 5 minutes (minimum)
3. After 5 minutes gradually close flex hose valve
4. Record CO2 stop time
5. Close CO2 valve on trailer and remove CO2 flex hose.
6. After 10 minutes have passed since CO2 was turned off, stop timer and record cycle stop time.
 - Trailer can be released and transported to Mortality Disposal Area during the 10-minute resting period.
 - Communicate end of cycle to Confirmation of Death Supervisor to allow for the unloading process to begin.

Process Manager will confirm Cycle STOP

7. Once the Process Manager has cleared the trailer, UNLOCK CO2 trailer and clear driver to re-enter cab

Cold weather considerations:

- *Use at least one CO2/O2 monitor inside (at the draftiest point near the end door) the depop trailer to measure gas levels. A CO2 displacement rate of 20% of the container volume per minute for 5 minutes will result in unconsciousness within 2 minutes. CO2 flow may be slower in cold weather and require longer fill times.*
- *Use a CO2/O2 monitor in the enclosed trailer to protect workers from overexposure*

Unloading

1. CO2 trailer will drive to Mortality Disposal Area
2. Engage the wet pack on the semi and tip the end dump trailer so the back door swings open but carcasses do not slide out
3. Confirmation of Death Manager looks inside the trailer for signs of life
4. Confirmation of Death Manager signals the driver to tip the trailer up until all carcasses are removed and confirms death as carcasses exit the trailer
5. If signs of life are noted, the animal will be euthanized by captive bolt
6. Confirmation Manager will report back to Process Manager any # of animals euthanized after cycle is completed