NAHEMS GUIDELINES:
MASS DEPOPULATION AND EUTHANASIA

FAD PReP
Foreign Animal Disease
Preparedness & Response Plan

NAHEMS
National Animal Health
Emergency Management System

USDA

APHIS

the Center for Food Security & Public Health
Iowa State University®

United States Department of Agriculture • Animal and Plant Health Inspection Service • Veterinary Services

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The Foreign Animal Disease Preparedness and Response Plan (FAD PReP)/National Animal Health Emergency Management System (NAHEMS) Guidelines provide a framework for use in dealing with an animal health emergency in the United States.

This FAD PReP/NAHEMS Guidelines was produced by the Center for Food Security and Public Health, Iowa State University of Science and Technology, College of Veterinary Medicine, in collaboration with the U.S. Department of Agriculture Animal and Plant Health Inspection Service through a cooperative agreement.

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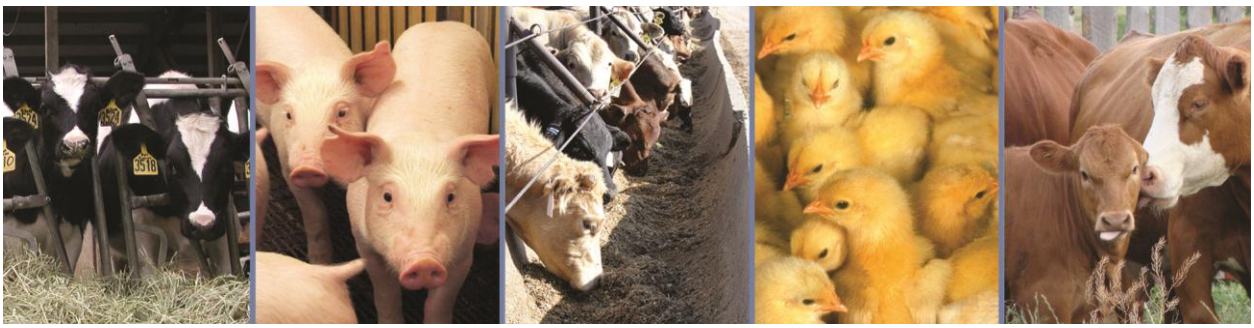
THE IMPERATIVE FOR FOREIGN ANIMAL DISEASE PREPAREDNESS AND RESPONSE

Why Foreign Animal Diseases Matter

Preparing for and responding to foreign animal diseases (FADs), like highly pathogenic avian influenza (HPAI) and foot-and-mouth disease (FMD), are critical measures to safeguard our nation's animal health, public health, and food supply.

There are significant potential consequences of an FAD outbreak in the United States. For example, the 2001 FMD outbreak in the United Kingdom cost an estimated £8 billion ($13 billion) and reduced the British gross domestic product by 0.2 percent. Studies have projected a likely cost of between $6 billion and $14 billion for a U.S. outbreak contained to California. In addition to the economic impact, the social and psychological impact on both producers and consumers would be severe.



Challenges of Responding to an FAD Event

An FAD outbreak will be challenging to all stakeholders. For example, there will be disruptions to interstate commerce and international trade. Response activities are complex, and significant planning and preparation must be conducted before an outbreak. Outbreaks can become large and widespread. Large, geographically dispersed and diverse teams will need to be assembled rapidly and must react quickly. The response effort must have the capability to be rapidly scaled up, involving many times more resources, personnel, and countermeasures. As such, responding to an FAD—large or small—may be a very complex and difficult effort.

Lessons Learned from Past FAD Outbreaks

Past outbreaks both in the United States and other countries have allowed us to learn important lessons that can be applied to preparedness and response efforts. To achieve successful outcomes in future FAD outbreaks, it is vital to identify, understand, and apply these lessons learned:

- Provide a unified State-Federal-Tribal-industry planning process that respects local knowledge
- Ensure the unified command sets clearly defined and obtainable goals
- Have a unified command that acts with speed and certainty to achieve united goals
- Employ science-based and risk-management approaches that protect public health and animal health, stabilize animal agriculture, the food supply, and the economy
- Ensure guidelines, strategies, and procedures are communicated and understood by responders and stakeholders

- Acknowledge that high expectations for timely and successful outcomes require the:
  – Rapid scale-up of resources and trained personnel for veterinary activities and countermeasures
  – Capability to quickly address competing interests before or during an outbreak
- Execute FAD tracing, which is essential for the efficient and timely control of FAD outbreaks

FAD PReP Mission and Goals

The significant threat and potential consequences of FADs and the challenges and lessons-learned of effective and rapid FAD response have led to the development of the Foreign Animal Disease Preparedness and Response Plan, also known as "FAD PReP." The mission of FAD PReP is to raise awareness, expectations, and develop capabilities surrounding FAD preparedness and response. The goal of FAD PReP is to integrate, synchronize, and de-conflict preparedness and response capabilities as much as possible before an outbreak, by providing goals, guidelines, strategies, and procedures that are clear, comprehensive, easily readable, easily updated, and that comply with the National Incident Management System.

In the event of an FAD outbreak, the three key response goals are to: *(1) detect, control, and contain the FAD in animals as quickly as possible; (2) eradicate the FAD using strategies that seek to stabilize animal agriculture, the food supply, the economy, and protect public health; and (3) provide science- and risk-based approaches and systems to facilitate continuity of business for non-infected animals and non-contaminated animal products.*

FAD PReP Documents and Materials

FAD PReP is not just one, standalone FAD plan. Instead, it is a comprehensive U.S. preparedness and response strategy for FAD threats. This strategy is provided and explained in a series of different types of integrated documents, as illustrated and described below.

FAD PReP Suite of Documents and Materials

Note: APHIS=Animal and Plant Health Inspection Service, NAHEMS = National Animal Health Emergency Management System, SOP = standard operating procedures.

- Strategic Plans—Concept of Operations
  - *APHIS Framework for Foreign Animal Disease Preparedness and Response:* This document provides an overall concept of operations for FAD preparedness and response for APHIS, explaining the framework of existing approaches, systems, and relationships.
  - *National Center for Animal Health Emergency Management (NCAHEM) Stakeholder Coordination and Collaboration Plan*: This plan describes NCAHEM strategy for enhancing stakeholder collaboration and identifies key stakeholders.
  - *NCAHEM Incident Coordination Group Plan:* This document explains how APHIS headquarters will organize in the event of an animal health emergency.
- NAHEMS Guidelines
  - These documents describe many of the critical preparedness and response activities, and can be considered as a competent veterinary authority for responders, planners, and policy-makers.
- Industry Manuals
  - These manuals describe the complexity of industry to emergency planners and responders and provide industry a window into emergency response.
- Disease Response Plans
  - Response plans are intended to provide disease-specific information about response strategies. These documents offer guidance to all stakeholders on capabilities and critical activities that would be required to respond to an FAD outbreak.
- Critical Activity Standard Operating Procedures (SOPs)
  - For planners and responders, these SOPs provide details for conducting 23 critical activities such as disposal, depopulation, cleaning and disinfection, and biosecurity that are essential to effective preparedness and response to an FAD outbreak. These SOPs provide operational details that are not discussed in depth in strategic documents or disease-specific response plans.
- Continuity of Business Plans (Developed by public-private-academic partnerships)
  - *Secure Egg Supply (SES) Plan:* The SES Plan uses proactive risk assessments, surveillance, biosecurity, and other requirements to facilitate the market continuity and movement of eggs and egg products during an HPAI outbreak.
  - *Secure Milk Supply (SMS) Plan:* Currently under development, the SMS plan will help facilitate market continuity for milk and milk products during an FMD outbreak.
- Outbreak Response Tools
  - Case definitions, appraisal and compensation guidelines and formulas, and specific surveillance guidance are examples of important outbreak response tools.
- State/Tribal Planning
  - State and Tribal planning is essential for an effective FAD response. These plans are tailored to the particular requirements and environments of the State or Tribal area, taking into account animal populations, industry, and population needs.
- Industry, Academic, and Extension Planning
  - Industry, academia, and extension stakeholder planning is critical and essential: emergency management is not just a Federal or State activity.
- APHIS Emergency Management
  - APHIS directives and Veterinary Services Memorandums provide critical emergency management policy. APHIS Emergency Management documents provide guidance on topics ranging from emergency mobilization, to the steps in investigating a potential FAD, to protecting personnel from highly pathogenic avian influenza.

These documents are available on the FAD PReP collaboration website: https://fadprep.lmi.org. For those who have access to the APHIS intranet, these documents are available on the internal APHIS FAD PReP website: http://inside.aphis.usda.gov/vs/em/fadprep.shtml.

PREFACE

The Foreign Animal Disease Preparedness and Response Plan (FAD PReP)/National Animal Health Emergency Response System (NAHEMS) Guidelines provide the foundation for a coordinated national, regional, state and local response in an emergency. As such, they are meant to complement non-Federal preparedness activities. These guidelines may be integrated into the preparedness plans of other Federal agencies, State and local agencies, Tribal Nations, and additional groups involved in animal health emergency management activities.

The Mass Depopulation and Euthanasia Guidelines are a component of APHIS' FAD PReP/NAHEMS Guideline Series, and are designed for use by APHIS Veterinary Services (VS), and other official response personnel in the event of an animal health emergency, such as the natural occurrence or intentional introduction of a highly contagious foreign animal disease in the United States.

The Mass Depopulation and Euthanasia Guidelines provide guidance for USDA employees, including National Animal Health Emergency Response Corps (NAHERC) members, on mass depopulation and euthanasia principles for animal health emergency deployments. This Guideline provides information for Euthanasia Group Supervisors and other personnel associated with mass depopulation and euthanasia activities. The general principles discussed in this document are intended to serve as a basis for making sound decisions regarding mass depopulation and euthanasia. As always, it is important to evaluate each situation and adjust procedures to the risks present in the situation.

The FAD PReP/NAHEMS Guidelines are designed for use as a preparedness resource rather than as a comprehensive response document. For more detailed response information, consult the FAD PReP Standard Operating Procedures (SOP): 13. Mass Depopulation and Euthanasia and plans developed specifically for the incident. Additional mass depopulation and euthanasia resources are included in the Appendix and in the references at the end of this document.

NOTE: This "FAD PReP/NAHEMS Guidelines: Mass Depopulation and Euthanasia 2011" is the result of a content update to the NAHEMS Operational Guidelines: Mass Depopulation and Euthanasia 2005.

APHIS DOCUMENTS

This "FAD PReP/NAHEMS Guidelines: Mass Depopulation and Euthanasia" has corresponding disease-specific FAD PReP Standard Operating Procedures (SOP): 13. Mass Depopulation and Euthanasia.

Several key APHIS documents complement this "FAD PReP/NAHEMS Guidelines: Mass Depopulation and Euthanasia" and provide further details when necessary. This document references the following APHIS documents:

- FAD PReP/NAHEMS Guidelines:
  - Appraisal and Compensation (2011)
  - Biosecurity (2011)
  - Cleaning and Disinfection (2011)
  - Disposal (2011)
  - Health and Safety (2011)

- FAD PReP Standard Operating Procedures (SOP):
  - 9. Biosecurity
  - 8. Health and Safety/PPE
  - 13. Mass Depopulation and Euthanasia

Many of these documents are available on the FAD PReP collaboration website at: https://fadprep.lmi.org
Username and password can be requested.

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National Animal Health Emergency Management System

Guidelines: Mass Depopulation and Euthanasia

1. INTRODUCTION

Euthanasia and depopulation (also known as "culling") may be practiced during an animal health emergency, such as a major disease outbreak or a foreign animal disease (FAD), to help prevent or mitigate the spread of the disease through the elimination of infected, exposed, or potentially exposed animals. It also serves to remove contaminated livestock from the food supply, protect the nation's agricultural and national economy, and safeguard public health. These guidelines provide the personnel associated with mass depopulation and euthanasia activities with guidance on selecting and using optimal euthanasia methods for a range of animals and situations.

The goals of euthanasia are to (a) provide humane treatment of animals at all times until they are euthanized; (b) select and use an acceptable form of depopulation/euthanasia to be executed as quickly, efficiently, and humanely as possible; (c) minimize the negative emotional and psychological impact on animal owners, caretakers, and the public; (d) prevent adulterated or potentially adulterated meat products from entering the food chain; and (e) prevent or mitigate disease spread in the event of the introduction of a FAD within the U.S. Qualified personnel must be proficient in the performance of depopulation procedures using the quickest, safest, and most humane methods practicable given the circumstances. During an FAD outbreak, depopulation measures are implemented to prevent or mitigate disease spread, thus protecting the economic viability of the agricultural industry and the nation and also—if the disease is zoonotic—the health and well-being of the public.

It is important to understand that USDA APHIS recognizes a difference between euthanasia and depopulation. Euthanasia involves transitioning an animal to death as painlessly and stress-free as possible. Mass depopulation is a method by which large numbers of animals must be destroyed quickly and efficiently with as much consideration given to the welfare of the animals as practicable. However, for the purposes of this document, the terms "mass depopulation" and "euthanasia" may be used interchangeably or simply be referred to as "euthanasia," regardless of whether they are actually considered euthanasia or depopulation.

These Guidelines focus on essential areas such as the responsibilities of euthanasia personnel and euthanasia considerations and methods. The document is designed for use not only in emergency situations but also in animal health emergency training programs. A brief overview of key elements of such programs is provided below.

2. EMERGENCY RESPONSE EXERCISES

Well before an animal health emergency strikes, euthanasia personnel should use these Guidelines in emergency response exercises designed to help them expand their knowledge of animal health emergency management. Such sessions will help personnel test detailed response plans that have been developed to respond to realistic emergency scenarios.

2.1 The First 24 Hours

A useful assignment challenges participants to use the Guidelines to create a detailed plan for the first 24 hours of an animal health emergency. Participants can use information in the guidelines to answer questions such as:

- What actions will need to be taken immediately? If these actions are not taken, what consequences are likely?
- What relationships with other key personnel, including individuals in the emergency management community, should be in place prior to the emergency?
- To what degree will mass depopulation or euthanasia of livestock disrupt the agricultural community? How can the effects of such disruptions be minimized?
- To what degree will mass depopulation or euthanasia of livestock disrupt the community at large? How can the effects of such disruptions be minimized?
- What key information and resources (e.g., equipment and supplies) need to be readily available, and where and how will they be obtained, stored, and accessed?
- What obstacles may appear, and how will they be overcome?
- What conflicting pressures are likely, and how will they be balanced?
- If an initial plan fails, what are the elements of an effective alternative plan?
- How will psychological stressors associated with euthanasia activities be mitigated?

2.2 Evaluation

The evaluation phase of test exercises will provide participants with the opportunity to use these Guidelines to (a) evaluate the strengths and weaknesses of their responses in the simulation exercises and (b) focus on ways to further enhance their strengths and improve their response capabilities in the event of an actual animal health emergency. The exercises also will underscore the need for participants to develop and maintain strong collaborative relationships with their counterparts in the emergency management community.

2.3 Interagency Outreach

If the presence of an FAD or other type of animal health emergency is detected in the United States, the appropriate local, State, and Federal agencies and their partners in the private sector (e.g., industry and academia) must respond in a coordinated, mutually supportive manner to (a) determine the nature of the outbreak, (b) initiate an appropriate response, (c) eliminate or control the disease, and (d) facilitate recovery (e.g., resumption of trade). The NAHEMS guidelines are designed for use at any of three levels of response commensurate with the severity of the outbreak. These levels include:

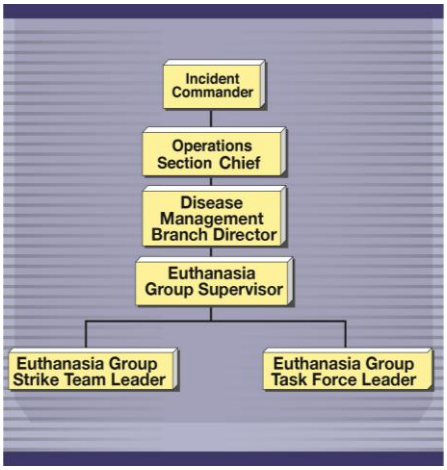
- **A local/limited response**. This level of response is managed by local level, with response coordination provided primarily at the local levels and with State, regional, and/or Federal consultation and consequence management (e.g., trade issues).
- **A State/regional response**. A State/regional response is managed by the State/region, and industry officials—in some cases, with the involvement of the appropriate State emergency management agency as specified in State animal health emergency response plans. National-level crisis management, response coordination, consultation, and consequence management are required and will be provided by the Federal government.
- **A national response**. Although Federal agencies act as the lead, this level of response requires the combined efforts of local, State, industry, and Federal agricultural officials as well as nonagricultural personnel from Government (e.g., the Federal Emergency Management Agency) and the private sector in national-level crisis management, response coordination, consultation, and consequence management.

Regardless of response level, the agricultural community must be prepared to work closely with the emergency management community to deal with an animal health emergency. The Incident Command System (ICS) is used to efficiently manage people and resources during an incident such as an animal health emergency.

The use of ICS as an emergency response approach has been adopted widely within the emergency management community. This Guideline refers to the titles of officials and groups in terms of the ICS model. The use of ICS terminology will promote the broadest possible application and implementation of this Guideline's content among the agricultural and emergency management communities. It is hoped that this approach will help the reader understand the essential aspects of animal emergency response activities within the context of this model. Under ICS, the Mass Depopulation and Euthanasia Group is a part of the Operations Section under the Disease Management Branch.

3. RESPONSIBILITIES OF EUTHANASIA PERSONNEL

When the decision is made to depopulate, interaction and collaboration with several groups occur. The Euthanasia Group, with approval from the Epidemiology Group and State Animal Health Official, determines the method(s) of depopulation. The Epidemiology Group and the Vaccination Group also play a role in the decision to depopulate in determining the method and extent of depopulation. Whenever possible, APHIS will comply with recommendations regarding the methods and approaches used for depopulation detailed in the American Veterinary Medical Association's (AVMA) Guidelines for Euthanasia as well as the recommendations outlined in Chapter 7.6 of the 2009 World Organisation for Animal Health (OIE) Terrestrial Animal Health Code.



All personnel should read and understand the procedures discussed in these guidelines. Personnel should also be trained or familiar with the use and proper maintenance of equipment used for mass depopulation and euthanasia as well as the hazards and other factors influencing efficacy of the described processes and procedures. Review of additional information sources (see the "References" and "For More Information" sections) and participation in educational sessions and/or emergency response exercises will help to expand knowledge and expertise of euthanasia principles and procedures.

Only qualified and trained personnel may perform euthanasia procedures. This section of the guidelines discusses the responsibilities of various euthanasia personnel as well as the importance of cooperation with other groups and units, including the Animal Welfare Group, the Disposal Group, industry stakeholders who may possess necessary equipment or be experienced in depopulation, and the Appraisal and Compensation Group. This Guideline also addresses the topics of hazard communication, biosecurity measures, personnel orientation, and needs assessment. The Euthanasia Group, which is located within the Operations Section, works closely with other groups and units to ensure a smoothly functioning operation. The Euthanasia Group

- Provides advice and recommendations to the Command level on euthanasia procedures (e.g., technical advice, briefings, daily reports);
- Notifies owners or operators of Affected or Contact Premises (potentially exposed) of mass depopulation or euthanasia procedures that will be used and secures acceptance for these procedures;
- Coordinates closely with the Logistics Section to secure the necessary equipment and supplies;

- Coordinates essential decisions such as scheduling and location of euthanasia activities with those planned by the Disposal Group;
- Coordinates euthanasia activities with other response Groups (e.g., the Appraisal and Compensation Groups); and
- Performs other services as appropriate.

3.1 Key Personnel

The Euthanasia Group consists of skilled and trained individuals who depopulate or euthanize livestock and poultry on affected and/or contact premises. Each Euthanasia Group may be responsible for a designated area or a certain number of premises. The following section details Logistic and Operations personnel considerations and responsibilities in the event of an animal health crisis. Sections on euthanasia and depopulation methods and considerations may be used by any organization or personnel involved in the process. The Incident Commander is charged with overseeing all activities related to the event, including Logistics, Planning, Operations, and Finance/Administration.

The number of personnel for the Euthanasia Group will vary depending on the size and scope of the incident. Key Euthanasia personnel would include:

- The Euthanasia Group Supervisor is in charge of all Euthanasia Teams (Strike Team and Task Force) and Euthanasia Team Members
- Euthanasia Team Leaders supervise Euthanasia Teams. Two types of teams may be deployed: a Strike Team or a Task Force; and
- Euthanasia Teams are responsible for activities at specific premises, euthanasia stations, or checkpoints; members may include personnel with expertise from multiple government and private sources

3.1.1 Euthanasia Group Supervisor

The Euthanasia Group Supervisor should be identified well before an animal health emergency occurs. This individual reports to the Disease Management Branch Director or Operations Section Chief and is in charge of all Euthanasia Teams, and has the primary responsibility for ensuring that euthanasia measures are implemented effectively during an animal disease emergency and that all euthanasia personnel are familiar with the proper euthanasia techniques for the specific incident being managed. This individual has extensive training and/or experience in the proper cleaning and disinfection methods following an animal disease emergency event and possesses the management skills needed to organize and direct all euthanasia activities for the incident.

The Euthanasia Group Supervisor should work with State emergency management agencies to identify Euthanasia Team Members with required expertise from multiple government and private sources and should advise the Operations Section Chief of any personnel requirements that cannot be satisfied locally so that arrangements for additional personnel can be made. The Euthanasia Group Supervisor will also work with appropriate officials to issue leases and contracts regarding equipment or personnel for the euthanasia operations. See Section 3.9 for a discussion of the 3D Commercial Services for personnel available through the National Veterinary Stockpile.

Additional duties of the Euthanasia Group Supervisor include:

- Maintaining up-to-date contact information on personnel willing and qualified to serve as Euthanasia Group members;
- Maintaining a working knowledge of any State and Federal regulations pertaining to euthanasia and mass depopulation;

- Determining the number and types of personnel, vehicles, and equipment needed to conduct euthanasia operations. This includes communicating with the Operations Section Chief to ensure that the required resources are available;
- Identifying personnel training requirements and orienting new employees to the specifics of their duties within the Euthanasia Group;
- Assigning Euthanasia personnel as necessary to achieve the goals of the Incident Commander;
- Ensuring that all new personnel receive the Safety Officer's briefing regarding on the job hazards;
- Coordinating Euthanasia Group activities with other response Groups (e.g., Carcass Disposal, Biosecurity, Surveillance, Appraisal);
- Supervising all personnel assigned to the Euthanasia Group;
- Coordinating with farm owners and/or managers regarding all phases of euthanasia;
- Verifying the accuracy and completeness of all required reports and submitting them promptly to the USDA-APHIS Emergency Management Response System (EMRS) or a similar acceptable reporting system. A Euthanasia Detail Form for each species euthanized will be completed as well as a Euthanasia and Disposal Summary Form;
- Preparing regular briefings and reports for the Operations Section Chief and notifying him or her immediately of any problems; and
- Cooperating with appropriate animal health emergency groups.

3.1.2 Euthanasia Team Leaders

The Euthanasia Team Leader will primarily focus on ensuring that safe, humane, effective euthanasia procedures are performed on animals in all premises involved in an animal health emergency. The Euthanasia Team Leader should be identified well before a disease outbreak or other animal health emergency occurs.

This individual:

- Assists the Euthanasia Group Supervisor in determining the number and types of personnel, vehicles, and euthanasia-related equipment needed to conduct depopulation and/or euthanasia operations;
- Instructs and trains Euthanasia Team Members in euthanasia protocols, policies and procedures, humane animal handling methods, and general safety precautions. Safety precautions are coordinated with the Safety Officer;
- Assigns tasks to Euthanasia Team Members and supervises their work;
- Serves as a liaison to various premises, informing owners and managers and providing technical and other additional information related to euthanasia activities as needed;
- Serves as a technical resource for information on current euthanasia and depopulation methods and procedures;
- Prepares briefings and reports for the Euthanasia Group Supervisor and notifies him or her immediately of any issues or problems;
- Works closely with other units and groups in the animal emergency response organization, particularly the Appraisal and Compensation Group whose activities precede euthanasia activities and the Disposal Group whose activities follow euthanasia. If approval is gained, then depopulation activities can begin or continue without prior appraisal. However, it is critical that the Appraisal and Compensation Group appraise animals before euthanasia activities begin whenever possible. Also, coordination and communication with the Disposal Group is recommended to prevent logistical problems with carcass disposal

3.1.3 Euthanasia Team Members

Euthanasia Team Members are typically assigned to a clearly defined area or premises. Personnel may be designated as Strike Team or Task Force Members. Depending on the size of the response, there may be several Euthanasia Strike Teams, each with its own Strike Team Leader. The Euthanasia Strike Team is composed of members who are experienced or trained in euthanasia SOP and can carry out animal euthanasia under supervision of or by order of a veterinarian. This team also may employ similar resources to carry out depopulation tasks on a specific or closely related premise. Team members have experience and knowledge in euthanasia techniques applicable to specific diseases.

The Euthanasia Task Force is composed of individuals with a wide variety of resources that may include addressing depopulation tasks related to multiple species or large, complex, or diverse premises. Team members typically have experience and knowledge in euthanasia techniques applicable to more than one species. In the event of an animal disease emergency, the work of the Euthanasia Team Members on an infected or exposed premises is essential to the containment and control of a disease outbreak. The Euthanasia Group Supervisor should assign duties to Euthanasia Teams as soon as possible after an infected or contact premises is declared.

Several State and Federal entities will have preceded the Euthanasia Group's arrival on a premise. A foreign animal disease diagnostician (FADD) or other designated official suited to address the emergency will have visited the premises to observe the animals for clinical signs of disease and to obtain diagnostic samples. Evidence of disease, which should be documented in the electronic medical record system or other agreed-upon alternative reporting system, will indicate that the animals and other materials on the premises are at risk of transmitting the disease. The U.S. Department of Agriculture (USDA) and Animal and Plant Health Inspection Service (APHIS) personnel are responsible for the final decision on whether to depopulate. The Epidemiology Group and the Vaccination Group also play a role in a decision to depopulate. The Euthanasia Group, with approval from the Epidemiology Group, the Animal Welfare Officer, and State Animal Health Official, determines the method of depopulation. The Incident Commander must approve the plan before implementation. The Appraisal and Compensation Group should also review with the State and USDA the process for the valuation, appraisal, and indemnification of animals.

All euthanasia personnel should learn as much as possible about the procedures discussed in these guidelines and in other information sources such as those mentioned in the previous section. They also should participate in educational sessions and emergency response exercises designed to expand their knowledge and expertise in the area of animal health emergency management.

3.2 Cooperating with the Animal Welfare Group

The Euthanasia Group should work closely with personnel from the Animal Welfare Group on all aspects of euthanasia related to animal welfare. The Animal Welfare Group is located in the Operations Section. Animal Welfare Group personnel will include qualified Veterinary Medical Officers and field personnel who have had training in animal welfare and depopulation procedures. These individuals will serve in an advisory capacity to ensure that animals are appropriately housed, maintained, and depopulated or euthanized humanely. A separate Animal Welfare Officer must be assigned to the group to consult with the Euthanasia Group Supervisor and monitor the operation. Before commencing, the method of depopulation or euthanasia must be approved by the on-site Animal Welfare Officer. The Euthanasia Group should make a concerted effort to

- Coordinate with personnel from the Animal Welfare Group for on-premises visits to help plan, implement, and observe euthanasia activities;

- Consult regularly with Animal Welfare Group personnel on animal welfare issues, requesting their advice as needed on individual questions or issues that arise;
- Make every effort to comply with the counsel of APHIS Animal Welfare personnel when it is reasonable and practical to do so

3.3 Hazard Communication

Euthanasia Group members should review the hazards associated with the euthanasia or depopulation methods likely to be used. The Team Leader should confirm that all personnel associated with the premises to be depopulated have been briefed on the depopulation procedure and any applicable euthanasia-related hazards. If requested, Euthanasia Group members can assist in communication of information to the owner, owner's family, and premises employees. Euthanasia Group members will coordinate closely with teams from other groups (e.g., the Appraisal, Biosecurity, or Disposal Groups) that may visit the premises.

Specific safety precautions or hygiene requirements should be explained to witnesses and stakeholders before the Euthanasia Group enters the premises. This is particularly important if a zoonotic disease is involved. Personal Protective Equipment (PPE) appropriate for the disease, situation, and individual will be supplied accordingly as determined by the Safety Officer. All PPE must be used according to guidelines established by the Safety Officer. Euthanasia Group Members should wear appropriate personal protective gear to ensure personal safety and compliance with Occupation Safety and Health Administration (OSHA) standards.

Additional biosecurity and cleaning/disinfection procedures may be required to address the risks posed by serious zoonotic diseases. Cleaning/disinfection procedures are outlined in *FAD PReP/NAHEMS Guidelines: Cleaning and Disinfection (2011).* Biosecurity measures are also extensively described in the *FAD PReP/NAHEMS Guidelines: Biosecurity (2011).*

3.4 Euthanasia Group Safety

In addition to the general hazards mentioned above, the safety of the Euthanasia Group may be affected by several factors, including:

- The size and body weight of the animals to be euthanized;
- The temperament of the species being euthanized. The Euthanasia Team will be able to implement euthanasia measures more safely, quickly, and humanely if they understand the animals' temperament and are experienced in handling the species;
- The animals' familiarity and comfort with humans. Special care and precautions must be taken if the animals are unaccustomed to being handled by humans;
- Animals generally regarded as being dangerous (e.g., bison, bulls, sows with litters, large boars, tusked boars, and all cervid species);
- Methods and/or equipment available for animal restraint. The restraining methods and equipment used must be sufficient to ensure the safety of team members. In addition, the means of restraint must facilitate the depopulation or euthanasia procedures and allow adequate time for its completion; and
- Methods and/or equipment chosen for euthanasia. Human safety is a primary concern when considering methods of depopulation or euthanasia. Hazards inherent to certain procedures such as free bullets, CO_2, and electrocution should be weighed when choosing equipment and methods

3.5 Personnel Orientation Factsheets

Certain sections of this document may be especially relevant to the responsibilities of individual euthanasia personnel. Accordingly, the Euthanasia Team Leader may wish to distribute one- or two-page laminated factsheets on various responsibilities or tasks to these individuals.

3.6 Personnel Briefings and Verification of Training

The Euthanasia Group Supervisor must identify all Euthanasia Group members and the specific tasks for which each is responsible. They also are responsible for credential verification, training, and security clearances for Euthanasia Group members. If necessary, the Euthanasia Group Supervisor arranges just-in-time training for personnel. However, just-in-time training in euthanasia methods should occur only when absolutely necessary, because the techniques often require practice to master. It is essential that personnel are properly trained in the euthanasia method(s) that will be utilized before they participate in euthanasia activities. No one will be allowed to enter premises without verified credentials. The Euthanasia Group Supervisor will also identify specific briefings required before euthanasia activities, including safety requirements, site conditions, and specific tasks.

3.7 Assessing Needs

The Euthanasia Group Supervisor, in consultation with leadership associated with the Euthanasia Task Force Leaders and Strike Team Leaders, will determine personnel needs such as vehicles and equipment. The Euthanasia Group Supervisor will work with State emergency management agencies to identify euthanasia personnel with the required expertise from multiple Government and private sources including industry stakeholders who may possess specialized equipment and/or training.

The Euthanasia Group Supervisor should advise the Operations Section Chief of any personnel requirements that cannot be satisfied locally so that arrangements for additional personnel can be made. The Euthanasia Group Supervisor also will work with appropriate officials to issue contracts and leases regarding any equipment, supplies, or personnel for euthanasia operations.

3.8 Partnerships with Industry Stakeholders for Euthanasia Activities

Expertise in euthanasia and mass depopulation may also be available within particular industries. For example, large poultry operations may have personnel trained in depopulation and may also possess associated specialized equipment. In some situations, industry stakeholders may be included in species-specific planning and assist in euthanasia activities. It is critical that participating personnel be trained in ICS to be successfully integrated into a response. In addition, involved industry stakeholders must embrace the importance of cooperation with other groups and units.

3.9 Depopulation, Disposal, and Decontamination (3D) Commercial Services

The National Veterinary Stockpile (NVS) is maintained by National Center for Animal Health Emergency Management (NCAHEM) through USDA-APHIS. The NVS is the nation's repository of veterinary countermeasures, including supplies, equipment, field tests, vaccines, and commercial support services. The NVS mission is to provide States the countermeasures they need to respond to catastrophic animal disease outbreaks that terrorists or nature may create.

As part of this mission, the NVS can also arrange service contracts for mass depopulation, disposal, and decontamination teams, called 3D Teams, if additional assistance is required. NVS will be mobilized as needed through pre-arranged coordination efforts with State Animal Health Officials, the VS area veterinarian in charge, the VS regional office, and the NVS director. For more information about the NVS, visit http://nvs.aphis.usda.gov.

These commercial services, provided through contracts with 3D Teams, can rapidly supply large numbers of personnel with equipment to support States that do not have sufficient personnel and resources. The 3D Teams are equipped to handle many types of emergencies and provide their own personnel, safety items, and equipment for most situations. They can be quickly mobilized and expanded to 600 personnel in three days, 1,000 in one week, and more if required.

When evaluating a disaster response situation, including mass depopulation, States that require additional resources can request assistance from a contracted 3D Team source. Once APHIS approves the 3D support, the approved State must provide a short statement of work. The NVS will assist with the process by providing examples of previous short statements of work. The basic information to include is a description of the support that is needed, the amount of support needed, and the location. It should be noted that funding must be available for initial tasks before a work authorization begins. Depending on the type of disaster, funding can be available from the USDA or FEMA.

For more information on the National Veterinary Stockpile and 3D teams, refer to:http://www.aphis.usda.gov/animal_health/emergency_management/nvs.shtml

For more information regarding the use of 3D teams, refer to:
http://www.aphis.usda.gov/animal_health/emergency_management/downloads/qa3dsupport.pdf

4. EUTHANASIA: GENERAL CONSIDERATIONS

In a major outbreak of highly contagious disease, large numbers of animals may be transmitting pathogens to other animals. Thus, the more quickly large-scale disease containment activities can be completed, the more rapidly pathogen transmission can be contained. During an animal health crisis, the goal of disease containment is to minimize depopulation activities while maximizing disease control. Modeling may be necessary to determine the optimal depopulation strategy during an animal health crisis.

Because timely initiation of depopulation or euthanasia procedures is critical to containing disease, euthanasia personnel must be familiar with general considerations that are essential to planning an effective euthanasia program. A thorough understanding of primary aspects of depopulation and euthanasia can help euthanasia personnel to act quickly and decisively in a crisis situation.

Central to successful euthanasia activities are factors such as using humane euthanasia methods, gaining public support for euthanasia activities, documenting the use of controlled substances, and minimizing personnel and owner stress. These factors are discussed below.

4.1 Humane and Aesthetic Considerations

Euthanasia should take place in such a way as to minimize an animal's pain and stress. To meet this requirement, the animal should be rendered unconscious as quickly as possible. Essential to the fulfillment of this objective are the careful selection of the quickest, most humane euthanasia methods, and skillful use of these methods on the part of the Euthanasia Team, as outlined in these guidelines. Public perceptions of the humaneness of the procedures used also are important, as discussed below. Euthanasia should be performed or closely supervised by a veterinarian, and each animal should be checked at the conclusion of the procedure to ensure that death has occurred.

Humane euthanasia requires personnel skilled in the various methods of depopulation as well as species-specific knowledge, which will also be covered in this guideline. Having skilled, trained, and educated euthanasia personnel and leadership not only improves animal welfare but also worker conditions in a highly stressful and potentially traumatic situation. Euthanasia personnel in various animal occupations have identified humane euthanasia as a key component to decreasing job stress (Baran et al. 2009, Figley & Roop 2006). A secondary or "backup" method of euthanasia should be available if the primary method of destruction fails.

4.2 Gaining Public Support

A major disease outbreak and response in this country can be expected to attract considerable media attention and interest, especially in the early stages of the incident. It is important that animal emergency response personnel gain the support of the public.

The media may be helpful in raising public awareness of the necessity of the depopulation or euthanasia activities in response to an animal health emergency. Appropriately crafted media messages will help the public to understand the need for destroying some number of animals and why this is being done to protect the food supply and the public health. The Education/Outreach Group and Public Information Officers will be primarily responsible for coordinating communications with stakeholders.

The euthanasia site should be protected from public and media personnel as much as possible. If feasible, euthanasia-related activities should take place in a barn, building, or areas where overhead covers such as canopies or tents can be utilized. This will help negate the effects of poor weather on activities as well as prevent or lessen the likelihood of inappropriate aerial photography and videos.

4.2.1 Animal Care Experts

As mentioned in a previous section, the Euthanasia Group will coordinate with personnel from the Animal Welfare Group for on-premises visits to help plan, implement, and observe euthanasia activities and will make every effort to comply with their recommendations.

4.2.2 Representatives of the Communications Media

The Public Information Officer will regularly update representatives of the media, including updates on euthanasia activities included in approved press releases. If possible, information will be provided to the general public on a proactive basis to educate them on the issues pertaining to disease eradication—including euthanasia—and to assure them of the appropriateness of depopulation procedures and humaneness of the chosen euthanasia procedures.

Representatives of animal welfare and animal rights organizations will receive the same information disseminated to the general public. There will be no other personnel permitted on site other than official or credentialed personnel. Non-credentialed visitors' safety cannot be guaranteed and may interrupt the efficiency of activities as well as the safety of credentialed personnel.

4.3 Documenting Use of Controlled Substances

If Federal employees utilize euthanasia solutions that are classified as "controlled substances", their use must conform to VS Memorandum 583.1 "Registration and Use of Drug Enforcement Administration (DEA) Schedule II, III, IV, and V Controlled Substances" dated June 17, 2005.This memorandum has been included as Appendix B.

Key components of the memorandum follow:

- Authorization for the use of euthanasia solutions will be given only by Area Veterinarians in Charge (AVICs) to a designated veterinarian responsible for controlled substances.
- Euthanasia solutions will only be dispensed to VS Area veterinarians for use only in their official capacity and for official purposes only. In addition to dispensing, the designated veterinarian responsible for controlled substances will also be tasked with ordering, receiving, and storing controlled substances.
- Unless directed by the Deputy Administrator of VS, the designated veterinarian will use the DEA controlled substances registration number only for ordering euthanasia solutions.
- Only a minimum quantity of euthanasia solution will be maintained on hand by the designated veterinarian responsible for controlled substances. This is the amount estimated to be used in one month by the veterinarians under the charge of the AVIC.
- The designated veterinarian responsible for controlled substances will dispense euthanasia solution to field veterinarians who require it for official activities. The amount dispensed must not exceed the estimated volume that would be used in a two-week period.

4.4 Human Psychological and Behavioral Aspects

When situations arise that warrant mass depopulation, veterinarians and technicians are at the forefront of depopulation, euthanasia, and disposal. Having to witness the effects of mass depopulation on families and communities provides additional emotional burdens on veterinarians and personnel carrying out euthanasia and depopulation duties. With these additional stressors, the human psychological response to euthanasia should be considered. To mitigate the negative psychological effects of involvement in mass euthanasia activities, psychological counselors should be made available to both staff and the stakeholders. Mass depopulation is emotionally draining on those whose animals are being depopulated as well as those involved with carrying out the euthanasia activities.

Compassion fatigue is a deep awareness of suffering of another and a wish to relieve it. Attending to the physical and emotional pain of another, which can be human or animal, can lead to a mental weariness known as fatigue. When a person feels compelled to be compassionate and help those that are suffering, they experience compassion stress. Compassion fatigue is the result of the demands of being helpful to those who are suffering. Compassion fatigue is a form of posttraumatic stress disorder (PTSD) and has been recognized in personnel working in a disaster situation (Figley & Roop, 2006).

There is a potential for compassion fatigue and PTSD for those participating in mass depopulation. Emotional and psychological stressors identified in the 2001 Foot-and-Mouth Disease (FMD) outbreak in the United Kingdom were inadequacy of training in technical protocol, inability to control chaos, insufficient interpersonal skills for the given circumstances, and lack of preparation for the consequences of decisions made (AVMA, 2007). Additional factors that are directly related to compassion fatigue which can lead to secondary PTSD are prolonged exposure to suffering or to a traumatic event by working extended hours, unresolved traumatic issues leading to traumatic memories, and other life demands (Figley & Roop, 2006). The 2001 FMD outbreak also highlighted the need for veterinarians to receive training and aid in dealing with the wide array of psychological and emotional responses from the producers, euthanasia personnel, and themselves (Nusbaum et al., 2007).

It has been reported that management and employees who had not received training for euthanasia-related stress reported an increase in longer term stress in comparison to personnel who had received some training (AVMA, 2007). The AVMA 2007 guidelines suggest that veterinarians responding to disasters should, at a minimum, be provided with training in psychological first aid (PFA). The John Hopkins Center for Public Health Preparedness has developed a six-hour training program for public health personnel (link to site listed in "For More Information"). Whenever possible, personnel involved in euthanasia activities should be trained to assess and acutely address the immediate psychological needs of people (including themselves) in distress situations. Further information on physiological stress hazards as well as information on the Employee Assistance Program is also found in the *FAD PReP/NAHEMS Guidelines: Health and Safety (2011).*

4.4.1 Minimizing Personnel Stress

Although mass depopulation and animal euthanasia is often a necessary step in disease eradication, extinguishing animal life is a difficult and often stressful process. The Euthanasia Group Supervisor, Task Force Leaders, and Strike Team Leaders should assess the experience and skills of euthanasia personnel and ensure that each individual has the information and skills he or she needs to implement euthanasia activities quickly, humanely, and effectively. This is critical in reducing euthanasia-personnel stress (AVMA 2007, Baran et al., 2009, Figely & Roop 2006). Euthanasia personnel also should be made aware of any available mental health counselors available on-site.

Several coping strategies have been identified in the animal and health care professions and it is recommended that they be communicated to all personnel involved with euthanasia. Studies have shown that the more confident workers feel in their abilities to euthanize, the less stress they experience (Baran 2009; Nusbaum et al 2007; Figley & Roop 2007). One way to reduce stress for workers is to increase their knowledge and skill set as it relates to the euthanasia or depopulation procedures being employed. Self-talk or cognitive strategies involve focusing on the positive outcomes or contributions a person is making by humanely euthanizing animals. It is imperative that the Euthanasia Group understand why it is necessary that animals be depopulated or euthanized. It should be emphasized to personnel that they are playing a critically important role in relieving animal suffering, relieving economic strife, and in protecting public health if there is a zoonotic threat.

Ideally, only experienced personnel will be involved with euthanasia activities. However, all personnel should expect to experience some degree of stress. Euthanasia Team Leaders should carefully observe personnel for signs of undue stress and be prepared to suggest a break, a shift of duties, a talk with a counselor, or other appropriate action. At the very least, team members should be encouraged to take frequent breaks, have regular meals, get adequate sleep, and engage in after-hours activities that provide opportunities for detachment and stress relief. Promoting these stress-relieving activities also helps prevent fatigue and stress-related accidents.

Predictably, some individuals will have continuing difficulty with the stress of participating in mass depopulation or euthanasia activities or mission assignments. If evidence of undue stress is observed, refer these individuals to available mental health counselors and shift these individuals to less traumatic roles in the disease-eradication effort. Critical incident stress debriefing should be offered (if not mandated) for all personnel involved with mass euthanasia activities.

4.4.2 Minimizing Stakeholder Stress

Public Information Officers should coordinate communication with stakeholders. This can be a traumatic experience for the stakeholder, and those skilled in communications and Departmental policy should moderate the interchange. It is usually recommended that the owner, the owner's family, and any employees not remain on the premises while mass depopulation or euthanasia activities are taking place, especially if the family includes young children and/or if family members or employees who have

emotional bonds with the animals concerned. As a matter of human compassion and consideration, the owner, their families, and employees should be provided with a complete explanation of what to expect. If the employees, owners, or family choose to stay on the premises while mass depopulation or euthanasia activities are implemented, they may experience considerable stress. Individuals who must deal with severe or prolonged stress reactions may wish to seek professional assistance. Community mental health facilities and religious institutions may be helpful in providing educational, counseling, and referral services for such individuals. The Euthanasia Task Force Leader or Strike Team Leader may meet with the owners, family, and/or employees to discuss this information and provide other details.

As mentioned above, the Euthanasia Task Force Leader or Strike Team Leader may, with the coordination of Public Information Officers and the Education/Outreach Group, meet with the owner, owner's family, and any employees prior to the initiation of euthanasia activities to

- Identify safety considerations concerning the proposed depopulation or euthanasia site, including the need to confine domestic pets and other animals not intended to be killed away from the site;
- Explain the depopulation or euthanasia method chosen and why it was selected;
- Suggest that the owner, the owner's family, and any employees consider leaving the premises while depopulation or euthanasia activities are proceeding; and
- Provide information regarding hotlines, agencies, facilities, or other resources designed to assist animal owners during animal health crisis

Careful advance discussion and disclosure of the depopulation or euthanasia activities with the owner, the owner's family, and premises personnel will help build trust in the Euthanasia Group's ability to handle the animals humanely and quickly. Full advance discussion also will increase the likelihood that once euthanasia activities have begun, the team will be allowed to proceed with its work without interruption.

5. GENERAL GUIDANCE FOR SELECTING A METHOD OF EUTHANASIA

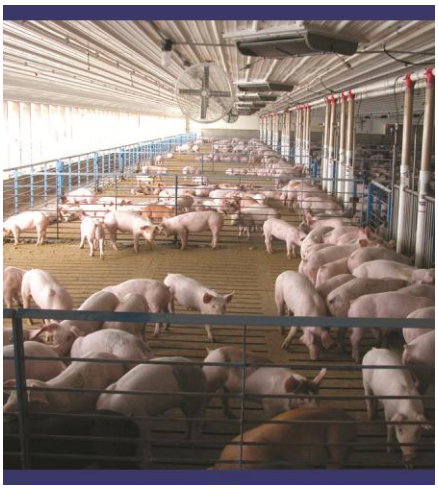
The selection of an appropriate depopulation or euthanasia method for a given situation involves consideration of a number of criteria. In general, the method selected must be appropriate to the species involved and implemented according to current professional standards. The method chosen is not limited to those specified in Title 9 CFR Part 313, *Humane Slaughter of Livestock,* because the four methods of humane slaughter listed there are specifically for animals being slaughtered for human consumption.

To ensure selection of the optimal and most humane euthanasia method for a given species, veterinarians with species-specific expertise and experience should be consulted during the planning process.

5.1 AVMA Guidelines

The AVMA has developed a document, "AVMA Guidelines on Euthanasia" (see http://www.avma.org/issues/animal_welfare/euthanasia.pdf and also in "For More Information" section) that provides recommendations and guidance for euthanasia procedures in animals. From the most recent (June 2007) version, the following guidance is relative to mass euthanasia: "Under unusual conditions, such as disease eradication and natural disasters, euthanasia options may be limited. In those situations, the most appropriate technique that minimizes human and animal health concerns must be used. The options include, but are not limited to, CO_2 and physical methods such as gunshot, penetrating captive bolt, and cervical dislocation." (p. 22)

When possible, the method chosen should be one that is accepted or conditionally accepted by the AVMA (refer to 2007 AVMA Guidelines on Euthanasia) and is in accordance with the OIE recommendations for killing animals for disease control purposes (presented in Chapter 7.6 of the Terrestrial Animal Health Code). The 2007 AVMA Guidelines on Euthanasia defines "conditionally acceptable" methods as "those techniques that by the nature of the technique or because of greater potential for operator error or safety hazards might not consistently produce humane death or are methods not well documented in the scientific literature…." (p. 3).



It should be noted that there are deficiencies in addressing key livestock areas in the most recent "AVMA Guidelines on Euthanasia." The document is currently under revision, and the new version is expected in late 2010 or early 2011.

5.2 Reference Materials and Training

Those personnel responsible for directing euthanasia operations should have a working knowledge of the goals for euthanasia outlined in Section 1 of these guidelines.

In addition to this Guideline, an associated document titled *FAD PReP Standard Operating Procedures (SOP): Mass Depopulation & Euthanasia* has been prepared. The Standard Operating Procedure, or SOP, is written to accompany the Guidelines and provide critical technical information related to what is described in the Guidelines. This SOP specifically documents the way euthanasia-related activities should be conducted so that a consistent conformance to recommendations and expectations can be facilitated. It is expected that personnel participating in euthanasia-related activities in the context of an animal health crisis will have read and understood all sections in the SOP document that apply to them.

An important component of euthanasia during an animal health crisis centers around the expertise of the individuals performing the euthanasia and its impact on animal welfare. **The role of proper personnel training in minimizing animal pain and stress during depopulation or euthanasia activities cannot be overemphasized**. It is critical that personnel who are assigned these responsibilities have appropriate training and experience with the animal species to be depopulated or euthanized and be knowledgeable and comfortable using the chosen method.

5.3 Materials, Supplies, and Equipment

It is critical that the materials, supplies, and equipment necessary to perform the depopulation methods recommended in the proposed euthanasia plan are available. A detailed list of equipment and supplies that are generally needed for depopulation are included in section 13.4.2 of the *FAD PReP Standard Operating Procedures (SOP): Mass Depopulation and Euthanasia.*

5.4 Sequence of Euthanasia Activities

Before euthanasia activities are initiated, animals designated for euthanasia must be appraised by personnel from the Appraisal Group to assure proper compensation of livestock losses. For further details see the *FAD PReP/NAHEMS Guidelines: Appraisal and Compensation (2011)*.

Euthanasia personnel should plan to euthanize the designated animals on premises in a sequence that takes into account the risk the animals pose for the spread of the disease agent. In general, animals should be euthanized in descending order of priority, as follows:

- Animals with the greatest propensity to shed disease agent (e.g., infected swine are reported to produce 100 to 1000 times greater concentration of FMD virus in aerosols than do cattle)
- Animals showing clinical signs of the disease of concern
- Animals that have had contact with the diseased animals
- Animals that are in an epidemiologically determined area of high risk (e.g., downwind of a swine herd infected with FMD)
- Animals susceptible to the disease of concern

Professional judgment should be exercised in determining exactly which animals are euthanized first. When prioritizing, consider animal well-being and humane issues, level of agitation of individual animals, and difficulty of handling individual animals. Specific animals slated for depopulation should be decided prior to initiation of depopulation activities. Euthanasia personnel should be cautioned to only euthanize those animals that are designated for euthanasia as part of the depopulation activities.

5.5 Method Selection

The on-site Animal Welfare Officer should be involved in selecting the most appropriate euthanasia method. For each depopulation/euthanasia situation, criteria for selecting the optimal method of depopulation/euthanasia should include the following:

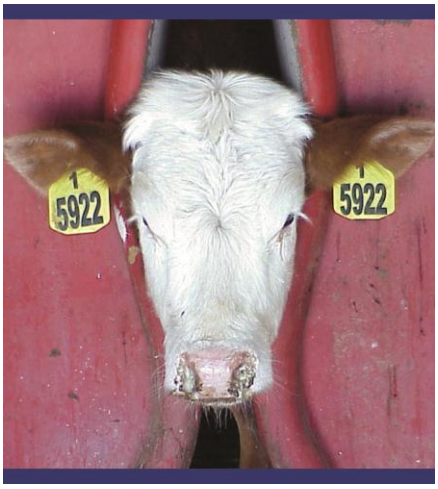
- Extent to which the method induces loss of consciousness and death in the animal quickly and with minimal pain, distress, anxiety, or apprehension
- Economy of manipulations (The method which requires the least number of steps and still meets the key objectives should be selected; so ideally, there is only one step in the kill process. A secondary or backup method of euthanasia should always be available.)
- Method's availability, reliability, and irreversibility
- Training, experience, and expertise level of available personnel for the method under consideration
- Virulence and pathogenesis of disease
- Personnel safety in implementing the method
- Biosecurity issues
- Method's compatibility with the situation's requirements and purpose (e.g., use of captive bolt when animals can be adequately restrained and gunshot when they cannot be restrained)
- Location of premises
- Number of animals to be euthanized (e.g., use of controlled substances may be feasible for euthanizing a small number of animals but not reasonable or practical for large numbers.)
- Potential negative psychological effect of the method on personnel, owners, and observers
- Location, size, weight and species of the animals to be euthanized
- Availability of facilities including adequate means of animal restraint (See next section for general considerations.)
- Compatibility of the method with subsequent plans for evaluation, examination, or use of animal tissue (e.g., the need to leave a cow's brain intact if it is to be analyzed for the presence of bovine spongiform encephalopathy)

5.6 Animal Handling and Restraint

Proper animal handling and restraint is essential to the depopulation/euthanasia operation. In all cases, the animals should be handled as calmly, quietly, and gently as possible. In general:

- Proper handling is important in minimizing animal pain and distress, ensuring the safety of the personnel performing the euthanasia procedure, and protecting other people and animals in the area.
- Gentle restraint, preferably in a familiar and safe environment, and careful handling and talking during depopulation/euthanasia can have a calming effect on animals that are accustomed to being handled. When evaluating methods of depopulation/euthanasia for wildlife or other animals that are not comfortable with human contact, the amount and type of handling required must be considered. Minimizing auditory, visual, and tactile stimuli can effectively calm these animals. In some cases, the use of tranquilizers or other chemical restraint may be necessary for humane or human safety concerns (AVMA, 2007). Some methods of depopulation/euthanasia require that animals be restrained physically by euthanasia team members. If individual animal restraint is necessary, ensure that an adequate number of properly trained animal-handling personnel are available before moving the animal from its housing.
- Hoofstock should be moved to the depopulation area by channeling through portable or on-site corralling. The terminus of the corralling will be a species-appropriate head-gate or squeeze-chute.
- Animals that cannot be handled safely should be euthanized in their customary housing, unless they cannot be easily extracted for disposal. Access by disposal crews is essential for any site selected for euthanasia.
- Personnel involved in the planning of livestock handling and restraint should be familiar with the species they are assigned to euthanize.

6. PRACTICAL METHODS OF MASS DEPOPULATION AND EUTHANASIA



The euthanasia methods used by personnel must be appropriate to the species involved, legal for use in the jurisdiction, and implemented according to current professional standards. Individuals making decisions regarding the method of euthanasia should be thoroughly familiar with the methods being considered.

While the use of euthanasia methods or agents listed by AVMA as being “acceptable” or “conditionally acceptable” are desirable with regard to public perception, there are new methods being developed which have not yet had AVMA Panel review. The “2007 AVMA Guidelines on Euthanasia” (formerly the “Report of the AVMA Panel on Euthanasia”) lists many methods of euthanasia. This document will primarily focus on those methods of euthanasia which are practical for mass euthanasia during disease outbreaks. Likewise, only species which could likely play a significant role in an agricultural disease emergency will be discussed in this document.

6.1 Physical Methods

Physical methods are an appropriate, and often a preferred, method of mass euthanasia. Personnel using such methods should be skilled in the physical technique or experienced in the use of the equipment. Extreme care should be exercised in performing procedures to prevent harm to the operator or others in the immediate area. Adequate training for inexperienced personnel and a clear demonstration of proficiency should be required before they are permitted to use an unfamiliar euthanasia method.

6.1.1 Captive Bolt and Gunshot Overview

Captive bolt and gunshot euthanasia are appropriate for most hoofstock and are similar in that they both target the cerebral region and the brainstem. In the hands of trained and experienced personnel, these methods produce a rapid and humane death. Both methods are especially useful when in field situations to euthanize numerous animals and/or avoid carcass residues associated with some chemical methods.

6.1.1.1 Penetrating and Non-Penetrating Captive Bolt

Penetrating and non-penetrating captive bolt devices are placed in contact with the skull to deliver a lethal blow to the animal through direct trauma to the brain when using the penetrating approach or concussive trauma when using the non-penetrating approach. Generally, the non-penetrating captive bolt is suitable for neonatal animals such as piglets in the weaning parlor and the penetrating captive bolt is used for larger juvenile and adult hoofstock. Traditional penetrating and non-penetrating captive bolts have not been specifically designed to result in death without a secondary step. In contrast, the more recent generation of captive bolt guns has produced devices designed with adequate force/energy and a longer bolt length to humanely kill livestock without the use of an adjunct step.

The use of an extended length penetrating captive bolt is usually fatal when properly conducted. Personnel must be prepared to administer an adjunct measure such as pithing or IV KCL administration to ensure rapid death if the use of the penetrating captive bolt fails to result in death. However, the use of non-penetrating captive bolts for euthanasia should *always* include an adjunct measure (e.g., intravenous administration of potassium chloride or pithing) immediately following bolting and determination of insensibility to ensure rapid death and prevent the possibility of an animal that may be only stunned from regaining consciousness. During any depopulation event, a veterinarian or an individual specifically trained to determine clinical death should inspect each animal to ensure that the operation was successful. The amount of energy necessary to adequately stun (not kill) an animal with a penetrating captive bolt weapon is approximately 200 Joules (J). This value will provide a starting point for further discussion about the muzzle energy requirements for stunning and killing of livestock.

6.1.1.2 Proper Use and Safety Considerations for Gunshot and Penetrating Captive Bolt

When gunshot is the method of choice, it is important that firearm handlers use a caliber of firearm, projectile, and propellant load that are appropriate for the species being euthanized, the location of the procedure, and the overall situation. The shooter should comply with all guidelines established by the Safety Officer such as the use of protective head and eye gear.

Guidelines for calibers of handguns and appropriate ammunition exist for use at point-blank range of discharge, i.e. the animal is restrained and the weapon is in close proximity to the skull. However, research is being conducted to determine the optimal caliber of firearm paired with the correct ammunition type to ensure a successful kill when discharged at distance. However until that research is completed, section 313 of 9 CFR provides that projectiles shall be "hollow pointed bullets; frangible iron plastic composition bullets; or powdered iron missiles." Hollow pointed bullets or other controlled expansion ammunition are desirable in two ways: first, to maximize tissue damage so there is little chance of an animal regaining consciousness, and second, to prevent the round from exiting the carcass and causing unintended damage. The downside of using a controlled expansion projectile is that, in case of collateral damage to a human, the wound will be much more severe than that produced by full metal jacket ammunition.

Full metal jacket (FMJ) rounds should NOT be used in a mass euthanasia situation. The use of the FMJ round was mandated by the Convention at The Hague in 1899. The purpose of enclosing bullets with full metal jackets was to reduce combat fatalities. If no major organs or bones were struck the bullets passed completely through the body without expending all their available energy and only wounded the victim. FMJ rounds also present a significant risk from ricochet, although no projectiles other than the fragile iron plastic composition and the powdered iron projectiles are completely free of that risk. To reduce noise and associated stress for both animals and people, the application of silencers to firearms should be considered whenever possible.

For reference purposes in choosing a suitable handgun for euthanasia of livestock, Table 1 (below) gives the weight of the projectile, muzzle velocity, and muzzle energy available with various handgun cartridges that are in common use. The weights of the various projectiles were deliberately kept as accurate as possible, except when the selection of possibilities was limited.

A firearm used for euthanasia of livestock does not have the inertial limitation of a captive bolt weapon. In the firearm, a powder charge pushes the projectile out of the weapon. Once the projectile exits the barrel it has no more effect on the weapon. In the captive bolt weapon, a powder charge propels the bolt (projectile) for only a short distance. The captive bolt weapon must then absorb all of the remaining energy that has not been expended penetrating the skull of the animal. The figure provided earlier for a captive bolt weapon is, necessarily, a compromise between having enough energy to reliably stun the animal and limiting the energy so that the weapon and operator do not take unnecessary wear and tear. Even with this compromise, the seals and stop washers in the captive bolt weapon must be replaced reasonably often in the course of normal maintenance. Inadequate gun maintenance is the primary cause of poor results with captive bolt stunning.

Providing the energy to reliably stun an animal is the purpose of captive bolt stunners. Inertial limitations do not apply to a firearm with a free projectile. The penetrating captive bolt stunner has a hard steel rod which will reliably penetrate the skull. A weapon utilizing controlled expansion projectiles or other "soft" projectiles needs several times the muzzle energy to ensure penetration of the skull. For this reason, it is suggested that a minimum of 300 ft lbs of muzzle energy be available for firearms used in mass euthanasia for animals up to 400 pounds body weight. For animals that are greater than 400 pounds body weight, at least 1000 ft lbs of muzzle energy should be available to ensure reliable skull penetration. In a mass depopulation situation, it is typically undesirable to stun the animal and have to apply an adjunct measure. The high muzzle energies suggested here are to ensure skull penetration and lethal effect such that adjunct measures will not be required.

With mature animals (e.g., bulls, swine, rams, or bison), skull penetration problems may be an issue even with the recommended 1000 ft lbs of muzzle energy. Thus, it may be necessary to switch from simple hollow point or controlled expansion projectiles to a projectile such as the Winchester Supreme®

Failsafe® which has a solid copper alloy nose with a notched hollow point cavity and a lead core protected by a steel insert. It is engineered for deep penetration through thick, tough skin, heavy muscle tissue, and bone. A round of this extreme penetrating ability should NOT be used for the average animal because ideally the spent projectile will never exit the animal but will expend all of its energy internally.

Comparing the recommended muzzle energies to those of the .380 Automatic or the .38 Special, it is evident that these cartridges should not be considered for mass euthanasia because they do not meet the minimum muzzle energy requirement. In contrast, excessively powerful handgun cartridges do not provide a significant enough advantage to justify the wear and tear on the operator. If higher muzzle energies are needed, a rifle is the logical answer.

Table 1 provides comparison information for some rifle cartridges in common use.

Table 1. Rifle Cartridges For Livestock Euthanasia

Rifle Cartridge	*Weight (g)*	*Muzzle Velocity (fps)*	*Muzzle Energy (ft lbs)*	*Energy at 300 yards (ft lbs)*	
.22 Long rifle rim fire	40	1150	117	-	Do not use
.22 Winchester Mag	34	2120	338	-	Do not use
.30 Carbine	110	1990	967	262	Do not use
.357 Magnum (rifle)	180	1550	960	385	
.223 Remington	64	3020	1296	574	
30-30 Winchester	150	2390	1902	651	
.308	150	2820	2648	1341	
30-06 Springfield	150	2920	2841	1442	

6.1.1.3 Aiming the Projectile

The "target point" for most animals can be located by drawing imaginary lines from the base of each ear, or in the case of cattle the horn buds, to the opposite lateral canthus of the eye. Where the lines intersect in the middle of the forehead is the proper entrance point. Between the eyes is not a correct entry point. Proper position is further discussed in species-specific sections of the guidelines. In the case of firearms, the angle of fire should cause the bullet to exit through the foramen magnum. Persons who have not studied the anatomy of the animal species being euthanized should have careful instruction to help them visualize the location of the foramen magnum since the path of the projectile is critical to successful euthanasia. In the case of a captive bolt weapon, it should be aimed as though the bolt is a free projectile as instructed above.

A working knowledge of the anatomy of various species is required to ensure that a properly aimed projectile enters the animal's brain and causes instant unconsciousness. All personnel and observers should be reminded that motor activity may continue for a time despite instant unconsciousness, especially in swine. Although captive bolt use is a reliable form of stunning, there are physical manifestations of unconsciousness commonly rendered by this method that should be discussed and understood by euthanasia personnel. When a standing animal is stunned, it should immediately drop to the floor. The neck and legs of the animal may stiffen and convulse for up to 10 seconds. Hogs commonly exhibit violent convulsions immediately after being stunned. After the animal is released from stunning box or chute, it is common for the legs to kick. Involuntary muscle spasms and leg movements have been

misinterpreted by people as the animal not being unconscious. Signs of consciousness include rhythmic breathing, blinking, eye movement, vocalization, and standing or attempts to stand. Excessive neck spasms and leg movement in cattle, vocalizations, or attempts to rise in any species are indications that the animal has not been properly stunned. Animals should be monitored for unconsciousness by observing a lack of palpebral eye reflexes, eyes rolled downward, limp neck (even though the legs may be moving), gasping/agonal breathing, or lack of respiration.

6.1.2 Non-Penetrating Captive Bolt

While many animals have been stunned by a blow to the head with a hammer back in the days of the "knocking box" in slaughter houses, technology has improved in the form of the penetrating and non-penetrating captive bolt. The non-penetrating captive bolt was developed to make the stunning of adult animals less physically demanding for the "knocker" and more controlled in its application. The penetrating captive bolt was discussed in a previous section. The non-penetrating captive bolt is similar in action to the penetrating; however, the "bolt" is mushroom shaped and, in contrast to the penetrating captive bolt, only forcefully strikes (**but does not penetrate**) and then retracts. When aiming the non-penetrating captive bolt, the target region is identical to that previously described for gunshot and the penetrating captive bolt. When used correctly in the appropriate species and age, the non-penetrating captive bolt effectively causes brain concussion and death. The non-penetrating captive bolt is simply a mechanized means to delivering a blow to the head. An adjunct measure must be available with the use of a non-penetrating captive bolt to ensure death.

6.1.2.1 Cautions and Considerations

A Safety Officer—a qualified individual other than the handler of the firearm—should be on site during all firearm-related euthanasia activities. As a safety measure, all nonessential personnel should be excluded from the site before firearm-related depopulation/euthanasia activity is begun. In addition, a medic should also be present during euthanasia activities.

Close coordination with the law enforcement agencies in the jurisdiction where mass euthanasia is taking place with firearms is critical so that all concerned can be aware of what is taking place. Special waivers for firearms use may need to be obtained from State, county, or municipal authorities depending on the location. The Chief of Police and Sheriff should be invited to planning sessions once the decision to use firearms has been made. The presence of a uniformed law enforcement person at a location where firearms are being used, if only at the premises entrance, is a positive image which can help allay public concern.

Euthanasia by penetrating captive bolt or gunshot is dangerous and should be performed only by a limited number of highly skilled personnel using captive bolt and/or firearms appropriate for the situation. Handlers should demonstrate a thorough understanding of the particular firearm or captive bolt to be used and should receive periodic training from an approved source in safe use and handling. Personnel should also have training and a thorough understanding of the species-specific requirements for captive bolt and firearm euthanasia. In addition, the Incident Commander must, in writing, approve all personnel who use firearms**.** Cleaning and maintenance of firearms is crucial, and all firearms must be properly cleaned and maintained according the user manual.

6.1.3 Blunt Trauma Delivered by Manual Force

6.1.3.1 Basic Information

The stunning of animals by a blow to the head is used primarily to euthanize neonates with thin craniums and is conditionally accepted by the AVMA to euthanize pigs less than three weeks of age. However, manual blunt trauma it is not a method recommended by the OIE. When euthanizing piglets using this method, a single sharp blow must be delivered to the central skull bones in the region over the brain. If

sufficient force is used, immediate depression of the central nervous system is produced and death occurs rapidly. Although this method is effective, it is aesthetically objectionable; requires practice and technical skill, and a considerable degree of strength and resolve to successfully complete the procedure. Thus, manual blunt trauma will not be used for euthanasia during an animal health emergency, and an alternative method should be selected.

6.1.3.2 Cautions and Considerations

A correctly applied blow to the head will produce death, especially in very young animals such as pigs less than three weeks of age. This method, however, is not recommended for neonatal calves because of their cranial structure. It also is not recommended for any adult animals because even a properly applied blow to the head may not sufficiently stun the animal. Although effective in certain cases, this method is physically and mentally taxing and requires a degree of skill and strength to be proficient. In addition, this method has a significant aesthetic repugnance for many people. Thus, the use of manual blow to the head is not recommended for mass euthanasia situations due to restraint problems, the likely chance of an animal moving to deflect the blow, the physical demand on personnel, and the probable aesthetic aversion.

6.1.4 Electrocution

Electrocution causes death by the passage of electrical current through the body, resulting in cardiac fibrillation and cerebral hypoxia. An animal must always be stunned either prior or simultaneously as an alternating current is passed through the body. Currently, there are portable swine-electrocution units available that are designed to deliver a 1000 volt death charge to swine as they pass under the electrode at the rate of approximately 600 pigs/hour. Using this technology, stunning and application of the lethal current are simultaneous. While an alternating electrical current can both stun and kill, an insufficient electrical current passed through the body from one random point to another may or may not cause unconsciousness depending on whether it passes through the brain, and therefore is not recommended. An animal electrocuted with insufficient voltage to produce immediate stunning will often remain conscious for a number of seconds following the onset of ventricular fibrillation. Passing an insufficient electrical current through the body without prior or simultaneous stunning will cause pain and, therefore, is not considered humane.

Electrocution can be accomplished in a one-step or a two-step operation. One-step stunning has been used effectively in ovine and swine species. In the one-step operation, the electric current is applied to the head and feet of the animal so that the current passes through the brain and heart simultaneously, producing unconsciousness and fibrillation of the heart.

In the two-step operation, electric current is first applied to the head and passed through the brain to produce immediate unconsciousness. This initial step only stuns the animal; it does not kill. Even if the current is large enough to cause physical damage to the tissues it passes through, the animal is likely to recover. Whatever adjunct measure is to be applied to ensure death must follow stunning immediately. As a second step, a sufficiently large alternating current is applied to the body so that it passes through the heart, causing ventricular fibrillation with resultant cardiac arrest and respiratory collapse.

The animals should be properly restrained so that the electrodes can be correctly applied. The electrodes should be attached firmly to the head and span the brain. For electrical stunning in swine, a pair of scissor-like tongs with electrodes at each end can be placed on the forehead or on both sides of the temple like ear muffs. Electrical stunning of sheep should be applied on the temples. Electrodes should never be placed over the eyes. Head-to-tail and foot-to-tail are not acceptable methods for stunning animals (Close et al 1996).

Small, hand-held stunners are available for killing poultry and may be suitable for smaller operations. The equipment that has been developed is readily transportable and can be set up on the farm so movement of live diseased poultry off of the farm would not be necessary. One drawback of this portable equipment is that it has been reported to be cumbersome to clean and disinfect.

Equipment for mass euthanasia of large animals should be constant-current devices capable of supplying 250v– 450v at 3 to 5 amperes and should operate at 60 Hz, which is normal power line frequency in the United States. The use of 120v electrical cords will NOT supply adequate amperage to render large animals unconscious. Voltages as low as 40V dc or 32V ac true room mean square (rms) are potentially dangerous. Although only 80ma to 100ma of current is required to produce ventricular fibrillation when applied directly to the heart, not all of the current flows through the heart when electrodes are applied to the exterior skin of an animal. Therefore, the higher values mentioned above are necessary to assure adequate current flow through the heart.

6.1.4.1 Cautions and Considerations

Although electrocution under controlled conditions is an acceptable method of euthanasia, when not carefully applied, its disadvantages often outweigh its advantages in proposed applications. The method is hazardous to personnel unless applied with equipment which is specifically designed for the technique. In addition, personnel must exhibit extreme caution because animals often jerk violently during electrocution. Electrocution euthanasia is not advisable if field conditions are wet or if the animals are wet, due to the danger of animals or personnel receiving electrical shocks.

Electrocution is impractical for mass euthanasia unless the equipment for the procedure and animal handling (e.g., conveyor restrainer) is portable and can be installed in a central location where large numbers of animals can be euthanized on an assembly line basis. For swine, the use of currently available portable electrocution units is feasible and is suitable for mass euthanasia because of the efficiency of operation. In addition, the use of centrally located equipment of the same design used in slaughter facilities has been successfully used in euthanizing large numbers of swine in the Accelerated Pseudorabies Eradication Program. It is possible that such equipment may be found in local slaughter houses which could be leased for the duration of an animal health emergency.

If electrocution is to be used in mass depopulation situations, the equipment should be obtained from the same manufacturers that supply the packing industry. These suppliers have the experience to produce equipment which operates reliably and efficiently and meets OSHA requirements for operator safety. Under no circumstances should makeshift equipment with minimal safeguards for the operators be utilized in the field.

6.2 Chemical Methods

In most cases the use of chemical methods to euthanize livestock during an animal health crisis is not practical because of the residue potential if carcasses must be rendered. This method should be considered only for unique circumstances such as euthanasia of pet livestock. The use of chemical methods is often perceived as being more refined and humane than the physical techniques discussed above. Although chemical methods of euthanasia are usually administered intravenously (IV), it is possible to add lethal doses of intoxicants to feed or water. To date, no broadcast intoxicants have been effective in any species that would not pose a hazard to man, the environment, or wildlife. Thus, it is strongly recommended that chemical euthanasia is limited to injectable methods. Any product to be used for lethal injection must be recognized as an effective and humane option. Barbiturate anesthetic agents meet these criteria and are the principle drugs used in several of the injectable euthanasia agents currently available. When considering barbiturates for mass euthanasia, cost and issues related to carcass disposal may be a significant deterrent for large animals.

6.2.1 Basic Information

Injectable euthanasia agents are most commonly administered IV but intraperitoneal injection also can be used if the euthanasia solution is non-irritating and does not have neuromuscular blocking properties. Proper animal restraint is critical for the success of both injection methods. The restraint applied should never cause excessive fear or stress. When the animals are not amenable to physical restraint, the use of chemical restraint or another method of euthanasia should be considered. Under some circumstances, restraining a dangerous large animal for intravenous injection of a sedative may prove difficult or impossible. In these circumstances, the animal may cause injury to itself or to personnel. In such cases, the animal can be given an intramuscular (IM) sedative. A number of products such as xylazine (analgesic, sedative), ketamine (dissociative), and phencyclidine (dissociative anesthetics) are not suitable for euthanasia but are excellent for chemical restraint or when dosed heavily in preparation for a lethal adjunct measure.

Chemical adjunct measures include injection of lethal amounts of products such as chloral hydrate, chloral hydrate and magnesium sulfate, or various alkaloid poisons. Potassium chloride (KCl) which is not controlled and is readily available will produce cardiac arrest when bolused by the intravenous or intracardiac route. The dose of KCl required is 7.2gm/100Kg of body weight. The animal should be rendered insensible before KCl is administered. Any product to be used as a lethal adjunct measure should be one with specific published clinical properties. Unacceptable injectable agents and methods of euthanasia are found in Appendix A.

6.2.2 Cautions and Considerations

Carcasses contaminated with injected euthanasia agents should not be left where scavengers have the opportunity to consume them and become unintended casualties. For proper disposal of these carcasses, refer to the *FAD PReP/NAHEMS Guidelines: Disposal (2011)*. Barbiturates have been particularly problematic in this regard when dosed at levels producing euthanasia. Many rendering companies will no longer accept animal carcasses with barbiturate residues because their products are incorporated into pet food. The potassium chloride mentioned above could be expected to be harmless to scavengers or pets. There should still be reasonable concern if chemicals have been used for restraint. If scavenging of carcasses by wildlife is likely or if rendering is the method of disposal, the use of physical methods of euthanasia rather than chemical methods is clearly indicated.

Since deep anesthesia can effectively mimic death, one drawback of injectable anesthetics is the need to absolutely determine that death has taken place. This can be done by way of close clinical examination or by the routine application of a lethal adjunct measure.

While unlikely in most countries, if the situation should ever arise that animals being killed in the course of disease control are intended for human consumption, use only those euthanasia methods which are specifically mentioned in 9CFR313, "Humane Slaughter of Livestock."

6.2.3 Gas Euthanasia Overview

Gas has been used in the mass euthanasia of poultry more frequently than it has with mammals. Carbon dioxide (CO_2) has been used commercially in slaughter houses to stun swine which were then exsanguinated. Carbon monoxide has been utilized for gas euthanasia in animal shelters with somewhat mixed success--likely due to variations in how the gas was generated. Because of the lack of consistency, the use of carbon monoxide will not be considered when planning euthanasia methods during an animal health emergency.

In cases where asphyxiants like carbon dioxide, nitrogen, argon, and carbon monoxide are used, personnel must be provided with appropriate training. Suitable safety equipment (e.g., a self-contained breathing

apparatus and oxygen equipment) should be available on site. All equipment must be utilized according to guidelines reviewed or established by the Safety Officer. Valuable technical information is also available in the *FAD PReP Standard Operating Procedures (SOP): Health and Safety/PPE*.

Any simple asphyxiant which will exclude oxygen and which is not noxious or irritating could, in theory, be suitable to euthanize animals. An animal exposed to an atmosphere which is completely devoid of oxygen will lose consciousness very rapidly. Nitrogen and argon have been specifically investigated in this regard and found to be effective. However, the AVMA recommends that animals are anesthetized or sedated heavily prior to the procedure. In addition, oxygen concentrations must rapidly decrease to less than 2%. Because of these restrictions, the AVMA has categorized the use of nitrogen and argon as "conditionally acceptable" and suggests that other methods be used for euthanasia.

6.2.3.1 Cautions and Considerations

The loss of consciousness is not typically preceded by obvious physiologic change, which can be demonstrated in the numerous human fatalities associated with accidental chemical asphyxiation. The lack of awareness and struggle before death may indicate that chemical asphyxiation produces rapid unconsciousness with low stress, but it also serves as a warning for human safety when working with such gases. For example, two human fatalities have been documented when the individuals were transferring semen straws from one liquid nitrogen storage container to another inside a van that was completely closed due to weather. The agitation of handling caused the release of enough nitrogen gas to lower the oxygen content sufficiently to kill the occupants with no sign of struggle. The number of reports of normal, healthy individuals being killed by suffocation in manure pits, silos, wells, and other confined spaces emphasizes the critical need for personnel safety precautions when working with asphyxiates.

6.2.3.2 Carbon Dioxide

Carbon dioxide (CO_2) has been used to euthanize a wide variety of animal species. This normal metabolic product is an anesthetic when used at sufficient concentrations (45% and above). The speed of induction is directly related to the concentration of CO_2. It is heavier than air, making it convenient to use in whole-house poultry depopulation where the CO_2 concentrates at the level of the chickens. When used outside in roll-off dumpsters, the top must be covered with a tarp to prevent wind from stirring the gas.

Carbon dioxide is readily available in several sizes of tanks, from those that can be hand carried to those that are permanently trailer-truck mounted. Generation of CO_2 from sources other than gas cylinders (such as from chemicals or fire extinguishers) is not recommended because inflow cannot be accurately measured and monitored. As with all euthanasia procedures, careful planning must take place. The containers must be correctly sized and have appropriate valves to regulate the gas so as not to freeze animals. All equipment must be used according to guidelines established by the Safety Officer.
The use of CO_2 is approved for euthanasia of domesticated breeds of sheep and may be presumed to be an option for goats, although its use in caprines is not mentioned in 9 CFR 313.5--which addresses the humane slaughter of livestock. Protocols are currently being developed for on-farm mass depopulation of swine using CO_2 gas, and it will likely be considered for approval. This method may also be used to euthanize small numbers of poultry or other avian species by using 40-gallon covered containers made of plastic or metal. When very large numbers of poultry must be euthanized, large roll-off dumpsters can be positioned outside the poultry house. In the United States, whole-house gassing is not a practical approach for mass depopulation of avian species. When tested in typical U.S. poultry management systems, it is excessively expensive, and euthanasia goals are not readily achieved. Thus, it is unlikely to be used for mass depopulation of avian species during an animal health crisis.

6.2.3.2.1 Cautions and Considerations

Compared to other euthanasia methods, time to death with the use of CO_2 is longer and, if concentrations are too high, some animals may exhibit signs of distress. A limitation to its use is the requirement that chambers or troughs be deep enough to totally submerge the animal. When CO_2 is used, the animal must either be left in the gas long enough to ensure that it is dead or a lethal adjunct method must be immediately applied. Animals which are removed from CO_2 exposure before clinical death are likely to spontaneously recover. Under no circumstances should animals be in physical contact with the solid form, "dry ice," because the extremely cold temperatures (-109.3°F or -78.5°C) would render this method inhumane.

7. GENERAL CONSIDERATIONS IN PLANNING EUTHANASIA ACTIVITIES

A number of issues must be considered when selecting the method of depopulation or euthanasia. A partial list of the issues includes:

- Animal species
- Size of the animals
- Number of animals
- Disposal of animals once euthanized
- Environment where animals are maintained (e.g., pasture, feedlot, dairy barn, swamp)
- Need for specialized equipment (e.g., firearm, gas chamber, chemicals)
- Public acceptance of depopulation or euthanasia method
- Risk of spreading the disease agent via euthanasia/depopulation procedure
- Human safety
- Hazard to the environment
- Weather and environmental conditions
- Degree of animal restraint required
- Sample contamination as a result of the euthanasia method

Each of these items should be listed, and a suitable remark drafted to provide "talking points" in case the method of depopulation/euthanasia selected is questioned at some future time. Other issues which are unique to the time, place, or situation should be added to the list to make as complete a document as possible. Since flexibility in planning is required during disaster events, it is not uncommon to change euthanasia plans several times before depopulation efforts begin. Once the euthanasia/depopulation method has been selected, modifications should be outlined and documented as previously specified. In addition, section 13.4.2 of the *FAD PReP Standard Operating Procedures (SOP): Mass Depopulation and Euthanasia* should be consulted. This section contains guidance for development of site-specific depopulation plans.

7.1 Personnel Considerations

Personnel-related criteria to consider in the selection of a euthanasia method include

- The availability of sufficient personnel to implement a given method (e.g., a number of personnel may be needed to help with animal gathering and restraint during euthanasia activities);
- The training, experience, and skill of available personnel;

- Willingness and attitude of personnel – each individual must make it a personal responsibility to assure that every animal handled and killed is treated in the most humane manner possible; and
- Personnel safety during the implementation of the method.

These factors are discussed in greater detail elsewhere in these guidelines.

8. PROTECTION OF THE PUBLIC

Euthanasia should be performed in such a way and in such a location as to ensure public safety and to screen the depopulation operations from public view. As mentioned earlier, the Education/Outreach Group and Public Information Officers will play a significant role in educating the public about disease eradication and in building public support for a disease eradication program, including euthanasia activities.

9. SITE SELECTION

The selection of a euthanasia site will depend on a number of factors. In general, the following criteria should be considered:

- **Consideration of bystanders and uninfected animals**. Animals to be euthanized should be moved away from bystanders and neighbors and from the view of the general public. Pet animals and other domestic animals not designated for mass depopulation or euthanasia should be confined well away from the euthanasia site. Care should also be taken to prevent any non-domestic animals from entering the area where euthanasia activities occur. Live animals infected with a highly contagious disease should not be transported past premises with susceptible species without adequate biosecurity measures. Biosecurity issues related to animal health crises are extensively discussed in the *FAD PReP/NAHEMS Guidelines: Biosecurity (2011)* and *FAD PReP Standard Operating Procedures (SOP): Biosecurity.*
- **Avoidance of the risk of harm to people and property from the euthanasia method**. If gunshot is used, for example, the euthanasia site should be located in such a way as to protect euthanasia personnel, premises buildings, and other livestock from stray or ricocheting bullets.
- **Availability of facilities and equipment, including methods of animal restraint**. Factors in regard to the amount of control and the kind of restraint required include the animal species, breed, degree of domestication, temperament, behavioral characteristics, size, and weight as well as the presence of pain or disease.
- **Logistics of disposal**. The Disposal Group should be consulted to ensure that their activities will not be hindered by an unacceptable site selection. Euthanasia activities should be located in an area where access is available for large equipment to haul carcasses to the disposal site if necessary. Ideally, animals will be euthanized on a platform or chute where, once death is confirmed, the carcass can be easily placed into a conveyance vehicle. See the *FAD PReP/NAHEMS Guidelines: Disposal (2011)* and associated SOP for further discussion on important disposal considerations.

10. EUTHANASIA OF DOMESTIC BOVINES

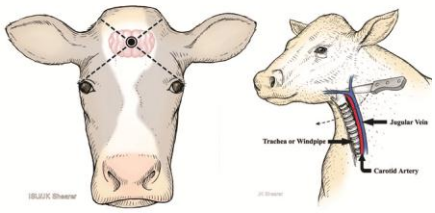
Three methods of humane euthanasia for domesticated breeds of bovine are specified in Part 313 of 9 CFR; *Humane Slaughter of Livestock*. These methods include captive bolt, gunshot, and electrical stunning/slaughtering. Although these procedures may need to be adapted for field conditions, they should be followed as closely as possible. Depending on the specific situation, these methods would be practical in the field situation for mass depopulation or euthanasia. The American Association of Bovine Practitioners (AABP) has designed an excellent resource entitled "Practical Euthanasia of Cattle," and details are available in "For More Information". Following the application of a euthanasia method, death must be confirmed in by the lack of a heartbeat and respiration.

10.1 Handling Considerations

Decreasing stress and excitement during movement and handling will ultimately increase bovine welfare as well as human safety and efficiency. In large-scale depopulation efforts for cattle, conveyors will likely be used to deliver animals efficiently to the captive-bolting stations. It is also possible that we may modify these conveyors to create a "tunnel electrocution" system. Use of the conveyors will reduce stress and increase efficiency of euthanasia activities. If a conveyor system is not used to deliver animals to a restrainer, then euthanasia personnel will move them. From a practical as well as a humane consideration, cattle must not be forced to travel faster than normal walking speed, and the use of electric prods must be kept to an absolute minimum, i.e. only used when an animal refuses to enter a holding pen, restrainer (if not using a conveyor system), or other area. Instead of electric prods or sticks, the use of human body position and flight zones as well as flags or plastic paddles or sticks with plastic ribbons attached to them should be utilized as much as possible to move animals. Cattle should be handled as quietly as possible on non-slip surfaces. Shouting, screaming, and other loud noises should be discouraged. In addition, the animals must be restrained in a manner that does not elicit injury or undue pain. Animals which are handled in a rough or hurried manner will become excited, making further handling unnecessarily difficult. As a humane consideration, non-ambulatory or disabled animals should be euthanized where they are and moved to the disposal site after death.

10.2 Penetrating Captive Bolt

Euthanasia of bovids by means of a penetrating captive bolt is both humane and efficient. Appropriate restraint must be used to ensure that the method is also relatively safe for personnel. Captive bolting in slaughter plants is intended to stun or render senseless the animal to be processed therefore requiring an adjunct measure (e.g. exsanguination or pithing) to be used.



Captive bolting in a depopulation setting will employ a modern extended captive bolt device in an attempt to deliver a fatal blow with one procedure. However, an adjunct measure must be available to ensure that the animal is humanely destroyed if the bolting action fails to produce near-immediate death. In a horned bovid, the ideal site for entry of a free bullet or captive bolt is at the intersection of two lines each drawn from the lateral canthus (or back of the eye) to the base of the opposite horn, as shown in the illustration at right. In an animal with a developed horn base, the line should originate from the center of the horn base. In a polled animal, the anatomical site where the horn base would be present should be closely estimated and then a line should be drawn from that point to the opposite lateral canthus (back of eye). If time permits, it is recommended that this reference point be drawn onto the head of the animal using a livestock-marking crayon or paint. This will increase the probability of proper bolt or free bullet placement. The muzzle of the penetrating captive bolt device should be firmly placed flat against the forehead of the animal so that the bolt is aimed toward the foramen magnum which is equivalent to aiming the bolt along the animal's spine in the neck region.

While proper application of an extended length penetrating captive bolt or gunshot is usually fatal, an adjunct measure (e.g., exsanguination via carotid or brachial arteries, pithing or thoracotomy, or an intravenous bolus of KCl solution) may be required to ensure rapid death. The use of an adjunct method complies with the OIE recommendation that an adjunct measure be used whenever captive bolts are applied. Once the animal has been dropped by the primary measure (e.g. bolting), a veterinarian or technician will need to verify death by brief examination. Attempting to elicit a response to corneal touch is a good general indicator that the animal is insensible. Death is confirmed by the lack of a heartbeat and respiration. If the animal has not been killed, then the adjunct measure must be applied. Exsanguination is not suited to the environment of a mass depopulation setting due to the potential of spreading infectious material and polluting the site. Pithing is often the preferred method, since it decreases exposure of potentially infectious material when compared to exsanguination. However, pithing has several disadvantages, including the possibility of aerosolizing brain tissue (potential Transmissible Spongiform Encephalopathy [TSE] exposure) and also involuntary movement (sometimes violent) in the animal. It is the latter disadvantage that is of greatest concern, since the filming of an animal being pithed could derail the depopulation effort due to objections by the public. Therefore, the use of an intravenous bolus of KCl solution to stop the heart in an unconscious animal will be the primary adjunct measure with pithing as a secondary adjunct measure.

10.3 Gunshot

Use of gunshot with species-appropriate ammunition and weapons of the appropriate caliber is considered a conditionally acceptable method of euthanasia for bovids according to AVMA guidelines. Factors to be considered in choosing suitable cartridges can be found in a previous section. Gunshot should be performed only by personnel with the appropriate skills, training, and experience. Safety guidelines jointly developed and agreed to by local law enforcement and the Safety Officer should be strictly followed. The application of silencers to firearms should be considered whenever possible to reduce noise and associated stress for both animals and people.

In the case of firearms used at close range, the point of entry for the projectile is identical to that just described for a penetrating captive bolt. When used at close range to place a bullet through the brain of an animal, the firearm should not be placed in contact with the head of the animal. Some automatic handguns will not discharge if any pressure is put on the muzzle of the weapon. Excess gas and particles will exit between the cylinder and barrel of revolvers if the muzzle is obstructed by placing it against the animals head, possibly resulting in serious human injury. The firearm's muzzle should be held 2-10 inches from the intended entry point on the bovine's head. In mature cattle and bulls the ossification of the skull may be adequate to deflect some projectiles, decreasing the efficacy of the method and increasing the hazard to personnel. For these animals, it is desirable to move the aiming point an inch to either side of the midline while maintaining the path of the projectile toward the foramen magnum.

It is generally unacceptable to consider the use of firearms to kill bovines at a distance farther than a few feet from the firearms operator. However gunshot at a distance may have to be used in some circumstances such as feedlots, rangeland, or when animals are stranded from flooding. A protocol is currently being developed to use firearms to euthanize cattle at an estimated distance of 30 feet. If long range use of a firearm becomes necessary to kill cattle which cannot be restrained or otherwise handled, another aiming point that can be used is half way between the eye and the base of the ear. The path of the projectile should cause it to exit through the same point on the opposite side of the skull if it has sufficient energy to exit. Do not target the chest or neck region.

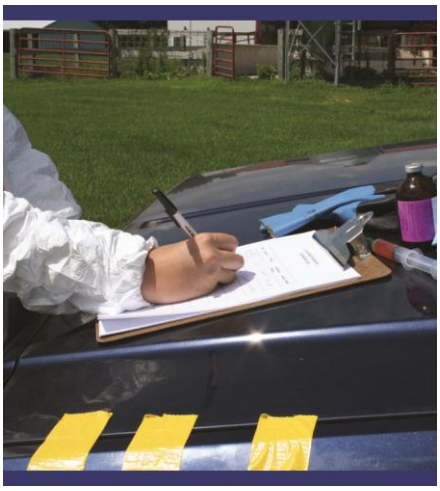
If skull penetration problems become evident, it may be necessary to switch from simple hollow point or controlled expansion projectiles to a projectile like that in the Winchester Supreme® Failsafe® which has a solid copper alloy nose with a notched hollow-point cavity and a lead core protected by a steel insert. It

is engineered for deep penetration through thick, tough skin; heavy muscle tissue; and bone. A round of this extreme penetrating ability should NOT be used for the average animal since the projectile may exit the animal without spending energy internally, which decreases the amount of damage.

10.4 Electrocution

With current technology, electrocution would be very difficult to apply to the bovine species as a method of euthanasia in the field. The handling that would be necessary with individual adult bovids makes this an unwieldy technique that should only be considered if there is no other practical method available. Personnel who administer this form of euthanasia are advised to tranquilize or sedate each bovid before attempting to attach the electrodes for euthanasia. The electrodes must be positioned to ensure that the electric current passes directly through the brain to achieve stunning. This can be accomplished either by positioning the electrodes from ear to ear or from poll to muzzle. After stunning, the electrodes would be repositioned to pass current through the heart and produce fibrillation. The electrodes would be positioned on the sides of the animal over the heart or on the anterior and posterior portions of the body. Development of an electrocution tunnel using a center-line conveyor to efficiently and humanely move animals is being currently being considered. If successfully developed, electrocution will be a much more feasible method to euthanize cattle during an animal health emergency.

10.5 Injectable Euthanasia Agents



The use of injectable anesthetics is usually impractical, even for very small numbers of bovids. The process will be necessarily slow because it requires prolonged individual handling and adequate restraint. In addition, this method is comparatively expensive and may make carcass disposal a hardship. Unless a Drug Enforcement Agency (DEA) unscheduled product (e.g. T-61) is made available, the adoption of a protocol utilizing injectable euthanasia agents in cattle is unlikely. Even if carcass disposal was not an issue, the required record keeping and special requirements of scheduled substances are strong deterrents to using this method for euthanasia during an animal health crisis. For livestock considered by the owner to be a pet or companion, the use of injectable products may be considered, particularly when the owner insists on being present during euthanasia. With mature bovids, the major drawback is the sheer volume of agent which must be injected and the resulting carcass disposal issues. An 1100 pound cow would require an estimated 110 ml of euthanasia solution. Prior to administration of injectable euthanasia agents, the use of an injectable tranquilizer is strongly recommended. A squeeze chute is an excellent method for restraining the animal and preventing it from falling on personnel as the drug takes effect. However, if the animal is allowed to die in the chute, extraction of the carcass from the chute is difficult and time consuming. To avoid this issue, personnel may administer approximately 1ml xylazine IV to the bovine while restrained in the chute. The animal should be released into a small holding pen where 10-20 minutes is allowed for the xylazine to take effect. Most animals will become recumbent within 20 minutes. Once recumbent, the animal can usually be haltered and easily euthanized by a single technician. In addition, multiple animals can be sedated in the chute and then released into a holding pen while the drug takes effect. This method is most effective when multiple animals are allowed to congregate in the holding pen before being euthanized. It is critical that personnel involved have advanced cattle handling skills.

Injectable solutions are the only currently available chemical euthanasia agents for cattle. However, intoxicants designed to be delivered into feed or water may be a future possibility for euthanasia of cattle populations. As stated previously, there are no intoxicants available that do not pose a hazard to man, the environment, or wildlife. Thus, this is not currently a recommended method of euthanasia.

11. EUTHANASIA OF DOMESTIC SHEEP AND GOATS

Four methods of humane euthanasia for domesticated breeds of sheep and goats are specified in Part 313 of 9 CFR; *Humane Slaughter of Livestock*. For both species, these methods include captive bolt, gunshot, and electrical stunning/slaughtering; and for sheep only, carbon dioxide is also designated and approved as a humane method. Although these procedures may need to be adapted for field conditions, they should be followed as closely as possible. Since this CFR focuses on humane slaughtering, it does not include other options outlined in the AVMA guidelines for euthanasia. These additional options include potassium chloride (only in conjunction with general anesthesia), chloral hydrate (animal must be heavily sedated first), and barbiturates. With proper planning and preparation, each of these methods may be practical in the field situation for mass euthanasia. Following the application of a euthanasia method, death must be confirmed by the lack of a heartbeat and respiration.

11.1 Handling Considerations

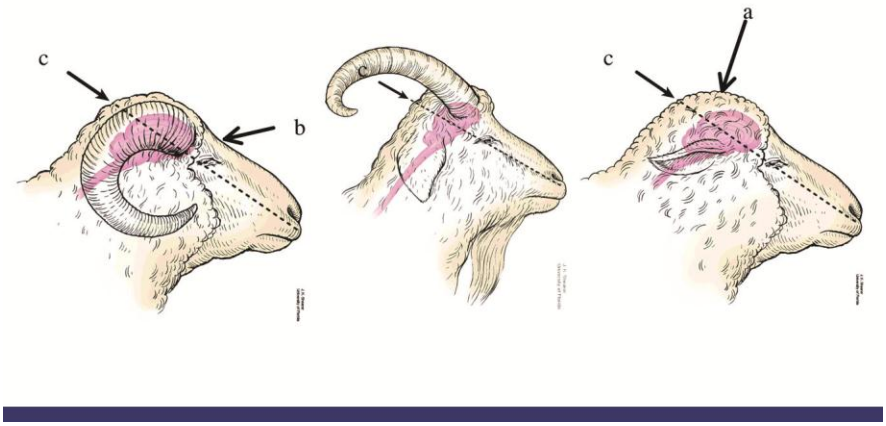
Decreasing stress and excitement during movement and handling will ultimately increase efficiency, animal welfare, and human safety. In large-scale depopulation efforts for small ruminants, conveyors (such as a center-line swine size conveyer unit) will likely be used to deliver animals efficiently to the captive-bolting stations. These conveyors may also be modified to create a "tunnel electrocution" system.

Use of the conveyors will reduce stress and increase efficiency of euthanasia activities. If a conveyor system is not used to deliver animals to a restrainer, then euthanasia personnel will move them. From a practical as well as a humane consideration, sheep and goats must not be forced to travel faster than normal walking speed and the use of electric prods must be kept to an absolute minimum, i.e. only used when an animal refuses to enter a restrainer or other area. Instead of electric prods or sticks, the use of human body position and flight zones as well as flags or plastic paddles or sticks with plastic ribbons attached to them should be utilized as much as possible to move animals. Sheep and goats should be handled as quietly as possible on non-slip surfaces and shouting and screaming should be discouraged. In addition, the animals must be restrained in a manner that does not elicit injury or undue pain. Animals which are handled in a rough or hurried manner will become excited, making further handling unnecessarily difficult.

As a humane consideration, non-ambulatory or disabled animals should be euthanized prior to moving and transported to the disposal site after death. Similar to cattle and hogs, the development of a center-line conveyor to efficiently and humanely move animals is being currently being considered. If successfully developed, euthanasia of large populations of small ruminants during an animal health emergency will be much more efficient. In addition, the decreased handling by humans prior to euthanasia may result in a more humane death for livestock unused to significant human interaction.

11.2 Penetrating Captive Bolt

Euthanasia of caprine and ovine species by means of a penetrating captive bolt is both humane and efficient. Appropriate restraint must be used to ensure that the method is also relatively safe for personnel. One point of entry for the penetrating captive bolt (see below) when used on polled sheep is the center of the highest point of the head with the bolt pointed straight down. In polled and horned sheep, the captive bolt may also target the area just above the eyes in the middle of the forehead. This point of entry also may be used for goat kids less than four months of age. When using this site, the operator must take care to align the captive bolt with the angle of the neck. In the case of horned sheep and goats, the captive bolt is placed immediately behind the ridge between the horns and angled to fire the bolt just slightly forward, toward the base of the tongue. Used correctly, captive bolt euthanasia produces a rapid death. However, personnel should be prepared to utilize a secondary procedure, such as intravenous administration of KCl solution or pithing.



11.3 Gunshot

The AVMA guidelines categorize the use of gunshot with species-appropriate ammunition as a conditionally acceptable method of euthanasia for sheep and goats primarily due to the associated potential for human injury. Factors to be considered in choosing suitable cartridges can be found in the previous subsection "Penetrating Captive Bolt and Gunshot." Advantages of gunshot euthanasia include the relatively little financial investment and the absence of carcass disposal issues related to toxins present in tissues. Gunshot should be performed only by personnel with the appropriate skills, training, and experience. Safety guidelines jointly developed and agreed to by local law enforcement and the Safety Officer should be strictly followed.

In the case of firearms used at close range, the anatomical site for entrance of the projectile is the same as for the penetrating captive bolt (see above). When used at close range to place a bullet through the brain of an animal, the firearm should NEVER be placed in contact with the head of the animal.
In mature horned sheep and goats the skull ossification may be adequate to deflect some projectiles. In these animals, it is necessary to be very sure that the aiming point is behind the ridge between the horns. The path of the projectile should be angled slightly forward toward the base of the tongue as described for the captive bolt weapon. It should be noted that the brain in the mature goat is much further back than might be expected. With species unfamiliar to a shooter, proper orientation and instruction should include demonstration skull specimens that have been sectioned lengthwise for clarity of anatomical landmarks. The application of silencers to firearms should be considered whenever possible to reduce noise and associated stress for both animals and people.

11.4 Electrocution

Electrocution as a method of euthanasia is categorized as conditionally acceptable by the AVMA. It may be difficult to apply to the caprine and ovine species in the field if adequate facilities are not available. With current technology, the individual handling that would be necessary with small ruminants makes this an unwieldy technique that should only be considered if there is no other practical method available. Personnel who administer this form of euthanasia are advised to tranquilize or sedate each animal before attempting to attach the electrodes for euthanasia. Development of an electrocution tunnel using a center-line conveyor to efficiently and humanely move animals is being currently being considered. If successfully developed, electrocution will be a much more feasible method to euthanize small ruminants during an animal health emergency. The electrodes must be positioned to ensure that the electric current passes directly through the brain to achieve stunning. This can be accomplished either by positioning the electrodes from ear to ear or from poll to muzzle. It is critical that the animal is rendered unconscious before proceeding. After stunning, the electrodes should be rapidly repositioned to pass current through the heart and produce fibrillation. The electrodes should be positioned on the sides of the animal over the heart or on the dorsal and ventral regions of the body. Similar to the use of gunshot and penetrating captive bolts, euthanasia using electrocution is especially advantageous when there are concerns regarding carcass disposal due to chemical contamination of the tissues.

11.5 Chemical Euthanasia Agents

Similar to the bovine species, the use of injectable anesthetics for caprines is usually impractical, even for very small numbers of animals. Compared to captive bolt and gunshot, this method requires more time and is more expensive. The process will be necessarily slow because it requires prolonged individual handling and adequate restraint. In addition, this method is comparatively expensive and may make carcass disposal a hardship due to contaminated tissues. Unless a Drug Enforcement Agency (DEA) unscheduled product (e.g. T-61) is made available, the adoption of a protocol utilizing injectable euthanasia agents in small ruminants is unlikely. Even if carcass disposal were not an issue, the necessary record keeping and special requirements of scheduled substances is a strong deterrent. Even so, the use of injectable euthanasia agents may be a practical euthanasia method for sheep and goats in certain situations. This option should be considered when animals have been hand raised (e.g., 4-H projects), particularly if the owner insists on being present during euthanasia. The previous section titled "Chemical Methods" covers general information on chemical euthanasia.

Potassium chloride--a non-toxic chemical--may be used to euthanize sheep and goats; but animals must be anesthetized prior to administration, and this greatly adds to the time expended per animal. Chloral hydrate may also be administered intravenously (900mg/kg) once the sheep or goat is heavily sedated. The length of time required to complete this procedure makes it impractical for most depopulation situations.

Intracardiac administration of a chemical euthanasia agent is an acceptable method, especially in young lambs or kids. The animals *must* be heavily sedated or anesthetized prior to intracardiac injection. Adequate restraint of even large individual sheep and goats is reasonable to do by hand, although the use of handling equipment and facilities will significantly reduce the stress on the sheep as well as operators. If sheep are unshorn, it may be prudent to clip the area over the intracardiac and/or jugular region to visualize for injection. A chute designed for small ruminants is an excellent method for restraining the

animal and preventing it from falling on personnel as the drug takes effect. However, if the animal is allowed to die in the chute, extraction of the carcass from the chute is sometimes difficult and time consuming. To avoid this issue, personnel may administer approximately 30-50 mg xylazine IV or IM to the sheep or goat while restrained in the chute. The animal should be released into a small holding pen where 10-20 minutes is allowed for the xylazine to take effect. Multiple animals can be sedated in the chute and then released into a holding pen while the drug takes effect. Most animals will become recumbent within 20 minutes. Once recumbent, the animal can usually be easily euthanized by a single technician.

11.5.1 Carbon Dioxide

Carbon dioxide **(**CO_2*)* can be used to euthanize sheep and may be presumed to be an option for goats; although use of carbon dioxide in goats is not addressed in 9 CFR 313.5. However, the extensive infrastructure necessary to handle a large number of animals makes it unlikely that this would be a suitable field method during an animal disease emergency. With careful planning, a truck or adequately tight room could be used as a chamber for CO_2 euthanasia.

12. EUTHANASIA OF EQUINE SPECIES

The AVMA Panel on Euthanasia has accepted the use of barbiturates and penetrating captive bolt for the euthanasia of horses. The use of cardioplegic agents such as potassium chloride for euthanasia is only acceptable for equids which are already under general anesthesia or have been rendered senseless by a physical method such as captive bolting. Part 313 of 9 CFR; *Humane Slaughter of Livestock* lists two methods of humane euthanasia for horses, mules, and other equines. These methods are captive bolt and gunshot. Although these procedures may need to be adapted for field conditions, they should be followed as closely as possible. With proper planning and preparation, these two methods would be practical in the field situation for mass euthanasia. In addition, some types of injectable chemical euthanasia, gunshot, captive bolt, and electrocution have been accepted or conditionally accepted by the AVMA for euthanasia of equines. Because it is unlikely that electrocution of equines would ever be accepted for euthanasia in an animal health emergency, this method will not be further discussed. In addition, choral hydrate is not commonly used to euthanize equines and may not be easily obtained. Thus, its use will not be further discussed in this document. Following the application of a euthanasia method, death must be confirmed by the lack of a heartbeat and respiration.

12.1 Handling Considerations

Section 313 of 9 CFR makes the same provisions for the handling of all livestock. For excellent resources on animal handling, please refer to the "For More Information" section. In summary, decreasing stress and excitement during movement and handling will ultimately increase equine welfare as well as human safety and efficiency. From a practical as well as a humane consideration, equids must not be forced to travel faster than normal walking speed. The use of whips and prods must be kept to an absolute minimum, i.e. only used when an animal refuses to enter a restrainer or other area. As many horses may react violently to the use of electric prods risking injury to themselves and personnel, their use is not recommended. Instead of electric prods or whips, the use of moveable partitions as well as hazing with flags, plastic paddles, or sticks with plastic ribbons attached to them should be utilized as much as possible to move animals. Equids should be handled as quietly as possible on non-slip surfaces, and shouting and screaming should be discouraged. In addition, the animals must be restrained in a manner

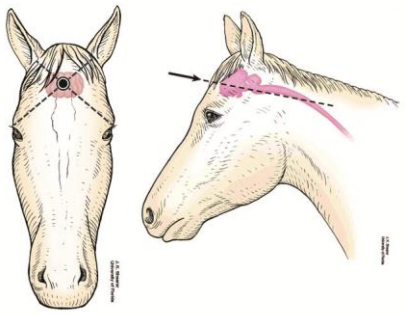
that does not elicit undue risk of injury or pain to themselves or personnel. Animals that are handled in a rough or hurried manner will become excited, making further handling unnecessarily difficult. As a humane consideration, non-ambulatory or disabled animals should be euthanized where they are and moved to the disposal site after death.

12.2 Sedation

In an emergency response effort, sedation or tranquilization of equines before euthanasia may not be possible due to time constraints. In addition, the use of chemical sedation may complicate carcass disposal. In some cases, such as for particularly fractious horses, sedation may be beneficial. If the horse can be approached safely, an IV dose of xylazine (.5mg/lb) will provide profound sedation within 5 minutes which will last for 15 to 20 minutes. If a horse cannot be approached safely, a pole syringe can be used to administer xylazine IM (1mg/lb) which will provide sedation within 15 minutes lasting for at least an half an hour.

12.3 Penetrating Captive Bolt

Euthanasia of equines by means of a penetrating captive bolt, with adequate restraint, is considered humane and is an acceptable method to AVMA guidelines. Adequate restraint to ensure operator safety and accuracy in bolt placement is critical. Fractious equines should be sedated prior to euthanasia if at all possible. The point of entry for the penetrating captive bolt when used on equines is at the intersection of two imaginary lines drawn from the base of the ear to the lateral canthus of the opposite eye. It is advisable to draw the point using livestock markers to increase precision of the captive bolt, but this may be impractical in a large-scale depopulation effort. The end of the penetrating captive bolt device should be placed firmly but gently flat on the forehead of the animal so that the "bolt" is aimed toward the foramen magnum. With the head of the animal in a normal postural position, the captive bolt gun will be at approximately a 45° angle to the horizontal.



Once the animal has been dropped by the primary measure (e.g. bolting), a veterinarian or technician will need to verify death by brief examination. Attempting to elicit a response to corneal touch is a good general indicator that insensibility has resulted. Death is confirmed by the lack of a heartbeat and respiration. The use of an extended length penetrating captive bolt and gunshot, when properly applied, are usually fatal. If, however, the primary measure fails, then an adjunct measure such as use of intravenous narcotics (disposal and control issues must be addressed), intravenous KCl solution, or pithing must be employed to ensure rapid death and prevent the possibility of an animal that is only stunned from regaining consciousness.

12.4 Gunshot

The AVMA guidelines categorize the use of gunshot only as a conditionally acceptable method of equine euthanasia because of its potential for human injury. Although classified as livestock by the USDA, horses are often considered companion animals by their owners. Thus, euthanasia using gunshot may be considered for equines as a last resort for horses due to their companion animal status and reaction to gunshot. Factors to be considered in choosing suitable cartridges can be found in the previous subsection "Penetrating Captive Bolt and Gunshot". Only personnel with the appropriate skills, training, and

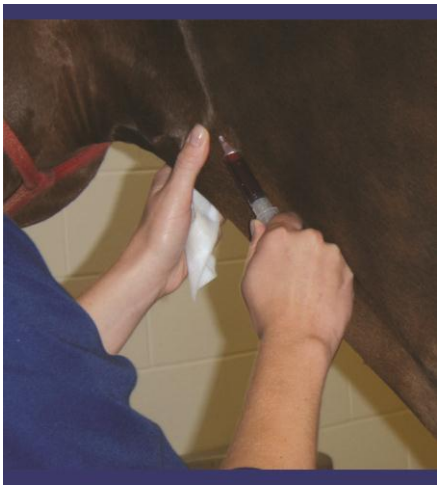
experience should perform gunshot euthanasia, and only in a setting that minimizes the risk to personnel and other animals. Safety guidelines jointly developed and agreed to by local law enforcement and the Safety Officer must be strictly followed.

In the case of firearms used at close range, the anatomical site for entrance of the projectile is the same as for the penetrating captive bolt (see above). For safety reasons it is imperative that the trajectory of the bullet should be such that it travels through the brain and down the neck in order to minimize the chance of the bullet exiting the animal. When used at close range to place a bullet through the brain of an animal, the firearm should NEVER be placed in contact with the head of the animal.

It is generally unacceptable to consider the use firearms to kill horses at a distance farther than a few feet from the firearms operator. However, it may be considered in extenuating circumstances such as stranded or starving/sick animals on rangeland. If long-range use of a firearm becomes necessary to kill horses which cannot otherwise be handled or approached, an alternative aiming point that can be used from the side of the animal is halfway between the eye and the base of the ear. In this instance, the use of a long gun is probably indicated as the accuracy of bullet placement is better than with a handgun. The trajectory of the projectile should cause it to exit through the same point on the opposite side of the skull. As the likelihood of complete penetration of the bullet is much higher with this aiming point, extreme caution regarding the background must be used when this aiming point is utilized. Due to the fractious nature of most wild horses, the use of noise suppression (silencer) may be advisable, but this may impact the ballistics of the projectile and the power of the weapon. Personnel should be prepared to approach the equine to ensure that death has occurred and perform an adjunct procedure if necessary.

12.5 Injectable Chemical Euthanasia

The use of injectable products should always be strongly considered when dealing with equids that are considered to be companion animals. This would be particularly true if the owner of the animal were to insist on being present during euthanasia. The sound associated with use of gunshot or captive bolt may result in unnecessary emotional distress to the owner.



The use of injectable anesthetics would be practical for tractable equines but the process will be necessarily somewhat slow because it requires individual handling and restraint. In addition, carcass disposal of equines euthanized with injectable agents may be problematic. Currently the most common injectable agents used for equine euthanasia are barbiturates. Major concerns in the use of injectable agents, particularly barbiturates, are the presence of residual chemicals in the carcass which may complicate carcass disposal and the issues of being a controlled substance. Sedation prior to administration of barbiturates is highly recommended.

Potassium chloride--a non-toxic chemical--may be used to euthanize horses; but animals must be anesthetized prior to administration, and this greatly adds to the time expended per horse. Although the use of potassium chloride is unlikely to result in carcass disposal issues related to tissue contamination, the drugs used to anesthetize the horse may. Although potassium chloride is much less expensive compared to barbiturates, the cost benefit may not be realized when the expense of pharmaceuticals required for anesthesia is figured.

To optimize safety and efficiency, the use of an intravenous catheter placed in the jugular is recommended to administer chemical agents. To decrease expenses, the catheters could be reused. One person should be assigned to handling the horse and should not be the same person who administers the

euthanasia agent. The euthanasia agent should be administered according to labeled directions and should be given as rapidly as practical. The handler should have received appropriate instructions on how to handle the animal and what to expect as the animal is euthanized to minimize risk to personnel. If needles instead of catheters will be used, strongly consider having two operators inject into the right and left jugular veins simultaneously using 18ga x 1 ½" or larger bore needles. This will significantly decrease the period of time when excitability might cause restraint problems.

13. MASS DEPOPULATION AND EUTHANASIA OF SWINE

Four methods of humane euthanasia for swine are specified in Part 313 of 9 CFR, *Humane Slaughter of Livestock*. These methods include carbon dioxide, captive bolt, gunshot, and electrical stunning/slaughtering. Although these procedures may need to be adapted for field conditions, they should be followed as closely as possible. Death must be confirmed in all animals following the application of a euthanasia method. Death is confirmed by the lack of a heartbeat and respiration.

13.1 Handling Considerations

Decreasing stress and excitement during movement and handling will ultimately increase swine welfare as well as human safety and efficiency. From a practical handling point of view, as well as a humane consideration, swine must not be forced to travel faster than normal walking speed, and the use of electric prods must be kept to an absolute minimum, i.e. only used when an animal refuses to enter a restrainer or other area. Instead of electric prods or sticks, the use of human body position and flight zones as well as sorting boards, flags, plastic paddles, or sticks with plastic ribbons attached to them should be utilized as much as possible to move animals. Swine should be handled as quietly as possible on non-slip surfaces, and shouting and screaming should be discouraged. In addition, the animals must be restrained in a manner that does not elicit injury or undue pain. Animals that are handled in a rough or hurried manner will become excited, making further handling unnecessarily difficult. As a humane consideration, and if human safety will not be comprimised, non-ambulatory or disabled animals should be euthanized where they are and moved to the disposal site after death. For excellent resources on animal handling, please refer to the "For More Information" section.

Euthanasia must be performed by competent personnel trained and experienced in swine euthanasia methods according to guidelines established by the Safety Officer.

13.2 Carbon Dioxide

Carbon dioxide (CO_2) can be used to euthanize swine. It has been used extensively in the slaughter industry for stunning as well as in the Accelerated Pseudorabies Eradication Program (APEP) for euthanasia. Protocols are currently being developed for on-farm mass depopulation of swine using CO_2 gas. The National Pork Board and American Association of Swine Veterinarians endorse CO_2 for smaller swine (i.e., weighing up to 70 lbs or 32 kg) and have provided detailed guidelines for euthanasia (see the link to these organizations' joint publication in "For More Information"). The weight limitation is applied because euthanasia of larger animals with CO_2 is not typically practical in a farm situation. This euthanasia method requires purchase or construction of special

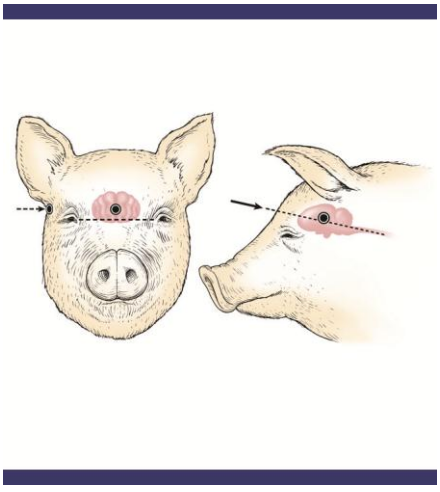
equipment and containers designed to handle swine. The containers must be correctly sized, contain appropriate valves to regulate the gas so as not to freeze animals, and ensure minimal distress is caused during induction. Care must be taken to ensure that CO_2 concentrations are between 80-90% for at least five minutes. With careful planning, a truck or adequately tight room could be used as a chamber for CO_2 euthanasia. If a slaughter plant is available within the kill zone that already has the necessary equipment for CO_2 stunning, this facility may be leased if possible. However, the transport of infected animals will only occur in extreme situations or if the animals are co-located at the slaughter facility. It must be emphasized that infected or exposed animals should not be transported in or through areas with previously unexposed livestock that are susceptible to the disease the swine are carrying. Transporting swine infected with a contagious disease such as Foot and Mouth Disease (FMD) could contaminate significant areas that may not have been affected prior to transport.

Although the skill level required to euthanize swine with CO_2 is low to moderate, human fatalities are still possible; and personnel must be provided with appropriate safety training. Suitable respirator equipment (e.g., a self-contained breathing apparatus and oxygen equipment) should be available on site. All equipment must be used according to guidelines established by the Safety Officer.

13.3 Penetrating Captive Bolt

Euthanasia of swine by means of a penetrating captive bolt is both humane and efficient. Animals must be properly restrained to minimize potential for improper stunning or human injury. For suckling and younger nursery pigs, they can be restrained by firmly and securely holding them, using a body sling, or lifting them using a two points of contact (such as one hand on their leg and one on their flank). Larger pigs can be restrained using specific restraining systems such as a center-line conveyor or snaring individually.

13.3.1 Aiming the Penetrating Captive Bolt



It is essential to aim the penetrating captive bolt correctly. In "On Farm Euthanasia of Swine—Options for the Producer," the National Pork Board and American Association of Swine Veterinarians recommend the following: For pigs weighing less than 300 pounds, the penetrating captive bolt should be placed firmly against the skull and directed at the midline of the forehead and half an inch above the eyes, which is even with the eyebrows. Aim the bolt at the brain and direct the bolt toward the tail. To accommodate the thicker skull structure of more mature pigs, the targeted point of entry should be adjusted to about an inch above the eyebrow line. It should also be moved just slightly to one side or the other of the skull ridge. If time permits, it is advisable to draw landmarks to increase efficacy of placement, as illustrated at right. There are significant differences between skulls of growing and adult swine; therefore, it is important to use an appropriate-sized bolt to ensure penetration for larger sows and boars. There are also breed differences that may make proper placement more challenging. Different charges are required depending on bolt length. For example, in sows and boars, the distance to the brain is often 4 inches from the surface; therefore, the charge must be sufficiently large to cause the appropriate length bolt to penetrate the skull of a mature animal. To determine the specific charge, personnel should refer to the operating manual for the particular captive bolt being utilized. Not all captive bolt weapons use variable charges. A more powerful .25 caliber cartridge is now in common use in captive bolt weapons.

As described previously, a new era of penetrating captive bolts has been developed and, used correctly, produces enough damage to the brain including the brain stem that it can be used as a single-step euthanasia device. These new captive bolts systems have several interchangeable captive bolts with varying lengths and thicknesses as well as several cartridges of varying strengths. The correct combination of captive bolt size and cartridge are determined based on pig size, age, and type (suckling, nursery, etc.). Because this system is designed to be used as a single-step euthanasia method that causes massive damage to the brain including the brainstem, the target location is moved slightly higher to maximize destruction of the brain stem. For market weight pigs (220-280 pounds), the targeted point of entry should be adjusted approximately one inch above the eyebrow line. For more mature sows and boars, the point of entry for the newer captive bolts should be 1.5-2 inches above the eyebrow line. If sows and boars in this mature category have a prominent skull structure, the target location may be adjusted slightly lower.

13.3.2 Use of Adjunct Methods with Penetrating Captive Bolt

Many variables can affect the energy with which a captive bolt imparts to the skull to produce unconsciousness or death in an animal. Therefore, the National Pork Board and American Association of Swine Veterinarians recommend use of an adjunct method (e.g., exsanguination by severing the brachial or carotid artery, or pithing) to ensure euthanasia if traditional captive bolts are used. Preliminary research indicates that for the captive bolts no adjunct methods are indicated if the correct combination of muzzle and cartridges of penetrating captive bolts are utilized.

13.3.3 Non-Penetrating Captive Bolt

Generally, the non-penetrating captive bolt is suitable for young animals such as piglets in the weaning parlor. Non-penetrating captive bolt devices are placed in contact with the skull to deliver a lethal blow to the animal through concussive trauma. The proper placement of the non-penetrating captive bolt is identical to that depicted in the illustration for a traditional penetrating captive bolt. The American Association of Swine Veterinarians has endorsed the use of the non-penetrating captive bolt as a primary means of euthanasia for suckling pigs up to 12 pounds. With the use of a secondary or adjunct step such as pithing or bleeding, it is also approved for nursery pigs up to 70 pounds. Because of the increased skull thickness in pigs over 70 pounds, the use of a non-penetrating captive bolt is not recommended for euthanasia of pigs weighing more than 70 pounds.

13.3.3.1 Monitoring Effectiveness of Use of Penetrating and Non-Penetrating Captive Bolt

Use of the captive bolt device, whether penetrating or non-penetrating, typically produces immediate collapse followed by a period of postural rigidity and then gradual relaxation. Often, correctly "bolted" pigs will have a period of involuntary kicking and paddling. Pigs that are rendered insensible should demonstrate signs such as lack of a corneal reflex, no deliberate movements, and no rhythmic breathing. If there is doubt as to whether a pig is insensible, the animal should be immediately re-stunned or an adjunct euthanasia method should be applied.

13.4 Gunshot

Title 9 of the CFR, Part 313, approves the use of gunshot as a slaughter method for swine, stating that "…firearms shall be employed in the delivery of a bullet or projectile into the animal…so as to produce immediate unconsciousness in the animal by a single shot" and "…with a minimum of excitement and discomfort." Use of gunshot with species-appropriate ammunition is a conditionally acceptable method of euthanasia for swine according to AVMA guidelines due to the potential for uncontrolled incidents. Factors to be considered in choosing suitable cartridges can be found in the subsection titled "Penetrating Captive Bolt and Gunshot." Only personnel with the appropriate skills, training, and experience in gunshot should perform the procedure. Safety guidelines jointly developed and agreed to by local law enforcement and the Safety Officer should be strictly followed.

The preferred gunshot ammunition for swine is a slug, due to reduced chance for ricochet, lack of stray shot, and improved accuracy and consistency. In the case of firearms used at close range, the "aiming point" for entrance of the projectile is the same as for the penetrating captive bolt (see above). The operator should be aware that the swine brain is located very high when considering the total mass of the skull. Persons unfamiliar with the anatomy of the swine skull should receive instruction with sectioned swine heads. When used at close range to place a bullet through the brain of an animal, the firearm should NEVER be placed in contact with the head of the animal. Large or aged adult swine typically have very thick skulls that may be difficult to penetrate with some projectiles. Thus, it is critical to use projectiles specifically engineered for extreme penetrating ability to avoid human injury or unnecessary animal suffering.

It is generally unacceptable to consider the use firearms to kill swine at a distance farther than a few feet from the firearms operator. However, it may be considered in very unusual and unique circumstances. If used at long range to kill swine which cannot otherwise be handled, another aiming point that can be used is half way between the eye and the base of the ear. This can be dangerous because the projectile may have sufficient energy to exit through the same point on the opposite side of the skull. Thus, the increased likelihood of free bullets and subsequent human injury makes this a hazardous method.

13.5 Electrocution

As a method of euthanasia, electrocution has been used successfully during the APEP operations. Electrical stunning and death by cardiac fibrillation are used extensively in the slaughter industry as well. The use of equipment from a supplier that provides electrical devices for the slaughter industry ensures the success of this technique. The USDA is currently investigating the possibility of using high-throughput mass electrocution units designed to deliver a simultaneous stunning/killing current. These portable swine electrocution units are designed to deliver a 1000-volt death charge to swine as they pass under the electrode at the rate of approximately 600 pigs per hour. Using this technology, stunning and application of the lethal current are simultaneous. If the high-throughput mass electrocution device is not utilized for euthanasia, then stunning with simultaneous cardiac arrest can be an acceptable euthanasia method. For this euthanasia technique, electrodes should be placed such that the current crosses the brain and the heart. This is accomplished by placing the first electrode at the level of the brain, often the depression at the base of the ear, with the second electrode placed on the opposite side of the animal, often in the flank region, so the electricity crosses the heart. The head electrode should not be allowed to slip onto the neck from the head position. This method requires a restraining device so that the animal does not fall away from the electrodes before a complete stun and shock occurs. If only head stunning is used, electrodes can be placed either on both sides of the temples like ear muffs or on the forehead. Electrical current must be applied for a full 2-3 seconds for a proper stun; however, the animal will remain unconscious for up to 30 seconds. An appropriate secondary kill method such as exsanguination or captive bolt needs to be applied within 15 seconds to avoid risk of the animal regaining consciousness. If the head-to-heart method of electrocution is used, the current must be applied for 15 seconds to achieve death.

13.6 Chemical Euthanasia Agents

General information regarding injectable euthanasia agents has been adequately covered in the section "Chemical Methods". The use of injectable euthanasia agents, although very effective, is a less practical mass euthanasia method for swine since the process requires a veterinarian to perform each euthanasia, and it entails prolonged individual handling and restraint. In addition, this method is comparatively

expensive and may make carcass disposal a hardship. Unless a Drug Enforcement Agency (DEA) unscheduled product (e.g. T-61) is made available, the adoption of a protocol utilizing injectable euthanasia agents in swine is unlikely. Even if carcass disposal were not an issue, the necessary record keeping and special requirements of scheduled substances is a strong deterrent to using this method for swine euthanasia during an animal health crisis. Injectable products are much more practical for the small porcine than for the adults because restraint problems are minimal in young animals. The use of injectable products might be considered when animal numbers are few or animals have been hand-raised (e.g., 4-H projects); particularly when the owner of a hand raised animal insists on being present during euthanasia.

Major drawbacks of using injectable euthanasia agents in swine include the large volume of euthanasia solution required, the relative difficulty of suitable venous access, and the potential carcass disposal issues of animals containing barbiturates or other anesthetic agents. For chemical euthanasia in animals over 100 lbs it is strongly suggested that euthanasia solution be injected into the anterior vena cava. However, this technique requires training and practice, and the potential for inadvertent extravascular administration of the agent is high. Thus, without personnel who have prior training and experience, this is not a recommended technique. In addition, the prolonged restraint may not be practical or safe in some field settings.

Sedation of swine over 250 lbs prior to euthanasia would be highly desirable if it were practical because larger animals are very difficult to physically restrain. While these animals can be sedated with ketamine, a suitable dose for restraint is in the range of 5 to 10 mg/lb IM. Since ketamine is normally supplied at a concentration of 100 mg/ml it, would require from 12 to 25 ml for a 250 lb animal. This dose must be placed in a muscle mass and not in fat. Although unlikely in a field setting, if the swine can be restrained adequately to inject into an ear vein, ketamine dosed at 2 – 5mg/lb can be used for sedation. However, IV injection of an ear vein requires significant restraint and facilities not typically found in a field setting. Note that xylazine, which has been recommended for sedation in many of the other domestic species is not effective in swine unless administered in combination with other drugs such as telazol and ketamine. This drug combination is expensive and would be cost prohibitive for mass depopulation.

14. MASS DEPOPULATION AND EUTHANASIA OF POULTRY AND OTHER PRODUCTION AVIAN SPECIES

Part 313 of 9 CFR; *Humane Slaughter of Livestock* provides no guidance regarding the slaughter of poultry which are defined separately from livestock throughout 9 CFR. Likewise, Title 7 United States Code, Chapter 48; Section 1902 makes no mention of poultry. Part 381.65 of 9 CFR, states briefly that, "Poultry must be slaughtered in accordance with good commercial practices…"

As required for the mammalian species, euthanasia must be performed by competent personnel trained and experienced in species-specific euthanasia methods. The animals must be restrained in a manner that does not elicit injury or undue pain. If the method used is dangerous to the operator, then the process must be carried out according to guidelines established by the Safety Officer.

When planning for mass depopulation due to disease outbreak, it is critical to consider the agent involved and zoonotic potential. Depopulation methods that reduce or eliminate contact between humans and the animal should be considered for diseases that pose a zoonotic risk to personnel.

14.1 Injectable Chemical Euthanasia

If only a few birds require euthanasia, an intraperitoneal injection of nonirritating euthanasia agent is an acceptable method. This will be the method of choice for destruction of companion birds if necessary. Ketamine hydrochloride (20-50 mg/Kg IM) can be used to provide restraint if absolutely necessary. Routine use of ketamine should be avoided because it is a scheduled substance and requires meticulous record keeping as well as secure storage.

When injecting chemical euthanasia into the peritoneal cavity, one can expect it to require an extended period of time (minutes) for absorption of the chemical. The time from administration to death is considerably prolonged when compared to intravenous methods. The use of oral avicides is not recommended because these chemicals may also be hazardous to mammals. Another draw-back to this method is that sick, injured, or otherwise stressed birds may not consume a lethal dose of the agent. In addition, the onset of signs after initial consumption of the avicide may cause birds to decrease intake of additional feed or water, thereby prolonging time to death. Attempts have been made to deprive flocks of food and water prior to depopulation with an avicide but results were not optimal (Weber 2007) and therefore other depopulation methods should be considered. Thus, intraperitoneal chemical euthanasia is much preferred over administration of an oral avicide.

14.2 Gaseous Agents for Euthanasia

Carbon dioxide (CO_2), nitrogen, and argon can be used to euthanize avian species. Carbon dioxide has been used extensively in mass euthanasia situations during past disease eradication programs. Because of the size of most poultry and birds, it is possible to euthanize small numbers in 40-gallon covered containers of plastic or metal. When very large numbers of poultry must be euthanized, large roll-off dumpsters can be positioned outside the poultry house, covered with plastic or tarpaulins, filled with >70% CO_2, and loaded with poultry. In all cases, the container must be covered to trap the CO_2 and prevent combining with normal atmospheric air. Tenting with plastic sheeting can be used to efficiently administer carbon dioxide in floor-housed birds. This method is not appropriate for caged laying hens or other poultry confined about ground level. To further streamline the efficiency of this method, the USDA plans to stock mobile dynamic CO_2 gassing chambers in the National Veterinary Stockpile (NVS).

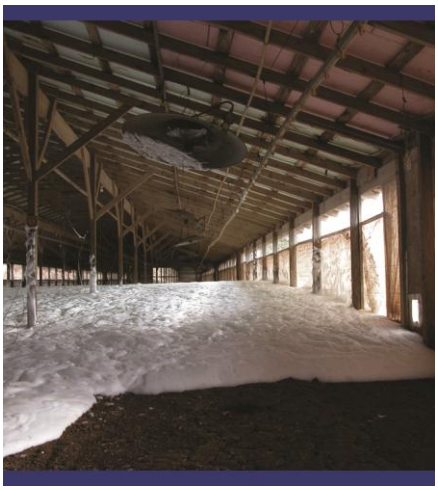
One significant drawback of this method is that it requires more human-bird interaction when compared to other methods. This is of particular concern when the disease agent has zoonotic potential. The possibility of exposure to disease is further potentiated because herding birds into the tented area stirs up dust which may contain the agent of concern.

Whole-house gassing decreases the exposure of people to live birds. In contrast to the tenting methods, there is no need for people to handle live birds unless the birds are caged. Caged birds must be removed from the cage and placed on the floor since higher CO_2 concentrations exist near the floor. Poorly sealed doors and fans provide potential outlets for CO_2 to escape and should be properly covered before administration of gas. An area near the roof of the buildings needs to remain open in order for atmospheric air in the building to escape while CO_2 is pumped in. Because of the density differences between CO_2 and air, the CO_2 will remain near the floor, which is especially useful for poultry depopulation. Special equipment is needed to avoid freezing CO_2 lines when pumping in large volumes of gas at a rapid rate. Also, if poultry congregate near gas inlets, they may experience extremely cold temperatures before full insensibility is reached. In the United States, whole-house gassing is not a practical approach for mass depopulation of avian species. When tested in typical U.S. poultry management systems, it is excessively expensive, and euthanasia goals are not readily achieved. Thus, it is unlikely to be used for mass depopulation of avian species during an animal health crisis.

When compared to carbon dioxide, the use of nitrogen or argon is somewhat more problematic because the specific gravity of these gasses is very near that of atmospheric air. Thus, they will not remain at the bottom of open container as readily as CO_2 will. To be acceptable, nitrogen or argon must be used in a completely closed (gastight) system, and the oxygen concentration must remain at less than 2% to ensure rapid loss of consciousness. Thus, the use of CO_2 to euthanize poultry is more readily accepted.

In cases in which asphyxiant or toxic gas is used, personnel must be provided with appropriate safety training. Suitable respirator equipment (e.g., a self-contained breathing apparatus and oxygen equipment) should be available on site. Personnel in full PPE can become very uncomfortable in warm weather over time (Webster 2007). All equipment must be used according to guidelines established by the Safety Officer.

14.3 Water-Based Foam



Water-based foam is a newer method being employed for emergency depopulation of land-based poultry and waterfowl. This foam is similar to that used by firefighters and is generated from a foam concentrate and air or an anoxic gas using specially designed equipment. Water-based foam, as well as other foam types, has been used for mass depopulation in the United States and other countries during avian influenza outbreaks. Poultry die from physical asphyxiation versus chemical asphyxiation as seen with CO_2 euthanasia. Studies have shown that asphyxiation by foam occurs more quickly than CO_2 tenting (Benson et al 2007). Other advantages include greatly increased speed of depopulation when compared to other methods; decreased labor because fewer personnel are needed for preparation and to execute this approach; and little or no bird handling is required. In addition, foam decreases dust and therefore airborne pathogens, and clean-up is minimal since the foam dissipates over a few hours. Although water-based foam has not been officially approved as a euthanasia tool, it is used and approved for poultry mass depopulation under APHIS specified emergency response conditions. If composting is used for carcass disposal, an additional advantage of the foaming process is that it adds necessary moisture to assist in-house composting. Disinfectants may also be added to the water/foam to help decontaminate the immediate environment.

Drawbacks to using foam include the cost of equipment and the rate-limiting step, which is the availability of water. Research is currently underway to investigate the use of foam application for depopulation of caged layers. If used in cage-free houses, slats and other objects that allow hens to be off the floor should be removed to ensure the maximum foam exposure to the birds (Webster 2007).

14.4 Cervical Dislocation

The practice of cervical dislocation for euthanasia of poultry should only be performed by well-trained individuals who are proficient with the technique. During training of personnel to perform this technique, the poultry should be sedated heavily or anesthetized prior to the exercise. Carbon dioxide in a suitable container may be used for anesthesia. Cervical dislocation is reasonable to use in smaller birds and when there are very small numbers of poultry being euthanized or when tissues are being collected.

14.5 Decapitation

The use of decapitation for euthanasia of poultry, while accepted as a humane method in certain conditions by the AVMA, cannot be recommended in most mass depopulation situations. This method is particularly offensive to onlookers as well as personnel and may pose a risk for disease spread. When

compared to other methods, it is also inefficient since each bird must be handled individually for a period of time. The handling, as well as the procedure, may cause undue stress in the animals as well as personnel involved. In addition, a debated welfare issue is that brain activity continues for at least 13-14 seconds post decapitation. Unless there is a need for collection of physically or chemically undamaged brain tissue, other methods of euthanasia are recommended.

14.6 Percussive Stunning

The Cash Poultry Killer (CPK) has been specifically designed for euthanizing poultry in emergency situations. When applied correctly, the CPK renders the bird immediately unconscious and kills the bird. The CPK is suitable for use on chickens, turkeys, ducks, and geese. There are two types of devices: 1) cartridge-powered and 2) air-powered. Although the cartridge-powered tool is excellent when an independent power source is needed, it may not be suitable for depopulating large numbers of poultry because it was not designed for high volume stunning. The cartridge must be replaced after each "fire" of the CPK, and the device may overheat when used continuously for an extended period of time. The air-powered CPK, originally intended for slaughter production purposes, is a better choice for large numbers of birds.

14.7 Electrocution

As a method of euthanasia, electrocution has been used successfully with poultry. The use of equipment from a supplier that provides electrical devices for the slaughter industry increases the success of this technique. Mobile electrical water bath systems have been designed for on-farm stunning and euthanasia of poultry and have proved useful in avian influenza outbreaks. The voltage on these machines is set at sufficient levels that birds are killed without the need for exsanguination as an adjunct method. One drawback to consider when using this technique is the need to individually handle and leg-shackle live birds. This may be a safety issue if a zoonotic disease is involved. In addition, there are no currently existing electrocution mass depopulation systems in the United States. Thus, this is not likely to be used to euthanize large populations of avian species.

14.8 Ventilation Shutdown

Ventilation shutdown is defined as the cessation of natural or mechanical ventilation of atmospheric air in a building where birds are housed, with or without action to increase the ambient temperature. Although this method has not yet been addressed by the AVMA, it is approved in the United Kingdom as a killing method for poultry in certain disease control situations. Compelling welfare concerns exist since it has not been determined if birds die from heat stress or suffocation. In addition, time to death has not been definitively established, and there are concerns that prolonged suffering may occur. Thus, this method is not recommended, and other euthanasia methods should be considered.

14.9 Gunshot

When euthanasia of small numbers of feral or wild birds becomes necessary, and they cannot be moved into a building or otherwise trapped, the use of shotguns with shot size appropriate to the size of the birds can be used. Gunshot may also be an appropriate euthanasia method for ratites and other large birds. This is not a suitable method for large populations of birds.

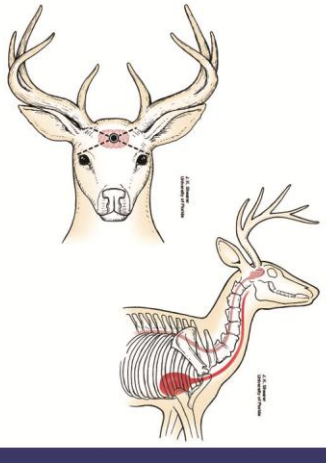
15. MASS DEPOPULATION AND EUTHANASIA OF NON-DOMESTIC ZOOLOGICAL AND EXHIBITION ANIMALS

In the case of zoo or game park animals, consult with expert handlers from a recognized facility, institution, agency, or association before selecting a euthanasia method. If animals closely resemble the domestic animals covered in previous sections, consider the methods discussed in those sections as a starting point in devising humane euthanasia methods. When zoological collections must be euthanized, the USDA will work with the resident staff veterinarians to develop and carry out euthanasia activities. Rather than take the lead, the USDA will provide support as needed. In other situations, such as captive game hunting ranches, the USDA will assume the lead role in euthanasia decisions. Non-domestic animals should not be handled by inexperienced personnel.

It should be emphasized that, even if they appear similar to domesticated species, non-domestic animals may not metabolize drugs or handle stress comparably. It is imperative that those with experience are sought out to develop a practical and humane euthanasia plan. The American Association of Zoo Veterinarians (AAZV) has published a comprehensive document titled "Guidelines for the Euthanasia of Nondomestic Animals." These guidelines are available for purchase at http://www.aazv.org/displaycommon.cfm?an=1&subarticlenbr=441.

The AVMA outlines conditional and acceptable forms of euthanasia, albeit more briefly than AAZV. It has found the use of barbiturates (IV or intraperitoneally), potassium chloride (only if the animal is under general anesthesia), or inhalant anesthetics as acceptable euthanasia methods for free-ranging wildlife. Conditionally acceptable euthanasia methods include the use of gasses (CO_2, CO, N_2, Ar) and captive bolt or gunshot. Kill traps which have been scientifically proven may also be utilized for euthanasia of free-ranging wildlife. Acceptable methods of euthanasia for zoo animal populations are designated by the AVMA as potassium chloride (only if animal is under general anesthesia), or inhalant anesthetics, barbiturates, and CO_2 or CO. Conditionally acceptable methods include the gasses N_2 and Ar as well as gunshot or penetrating captive bolt.

Euthanasia must be performed by competent personnel who are trained and experienced in species-specific euthanasia methods. The Safety Officer should be consulted where handling the animals may cause significant danger to the personnel. In all cases, the animals must be restrained and handled in a manner that does not cause injury or undue pain. The procedures and facilities used for the restraint and euthanasia of these animals must be humane and compatible with the needs of the species involved. Following the application of a euthanasia method, death must be confirmed by the lack of a heartbeat and respiration.



15.1 Captive Bolt or Gunshot

If it is not feasible to capture and restrain the species of animal to be euthanized, gunshot may be the only practical option. When choosing the euthanasia method, consider that non-domestic animals may experience extreme stress when handled and restrained for certain types of euthanasia, making free bullet the choice method. For cervid species such as deer and elk, if the animal can be restrained chemically or physically, use of a captive

bolt or free bullet is an acceptable method of euthanasia. In cervids, aim the captive bolt or gun at the intersection point of two imaginary lines drawn from the middle of the base of the ear to the lateral canthus of the opposite eye. You may also aim the bolt or bullet down the center of the horn ridge aiming at the base of the tongue, similar to horned sheep (see Section 8.2). See the specific guidelines on the selection of firearms and ammunition provided in and earlier section titled "Penetrating Captive Bolt and Gunshot".

15.2 Injectable Euthanasia Agents

A wide variety of projectile equipment (e.g., Palmer Cap-Chur) utilizing very powerful restraint agents is accessible to veterinarians specializing in zoo animal or wildlife practice. Therefore if this equipment and these agents are to be used, veterinarians with the specialized training to use them safely should be employed. In an animal health crisis event when a decision to euthanize captive ruminants, or wild, exotic, or zoo animals has occurred, expert opinion is critical for success.

16. MASS DEPOPULATION AND EUTHANASIA OF FARMED/AQUATIC SPECIES

The farmed fish industry is a growing industry in the United States. Similar to exotic mammals, expert opinion must be sought if farmed fish/aquatic species must be depopulated. As described in the previous section, the AAZV has published a comprehensive guide to euthanasia of non-domestic animals and guidelines for euthanasia of fish populations have been included in this document.

When harvested, farmed fish are most commonly stunned by electrical or percussive stunning. If fish are dispatched at an industrial facility, such as salmon or trout plants, the use of mechanized percussive stunners is commonplace. The stunning procedure is typically followed by exsanguination. The Humane Slaughter Association recommends the use of mechanized stunning to avoid stressful handling by humans. Fish may be euthanized using tricaine methane sulfonate solution. Overdoses of immersion agents and some injectable euthanasia agents may also be used. For further information on aquaculture and farmed fish, see "For More Information".

Currently, there is little published concerning humane euthanasia procedures for aquatic species, particularly fish. As the AVMA updates their euthanasia guidelines, it is currently seeking expert input regarding this issue. In an event involving depopulation of farmed fish/aquatic species, veterinary and husbandry experts in these fields should be consulted for expertise and guidance.

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American Association of Swine Veterinarians
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Euthanasia
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Continuing Education
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"On-Farm Livestock Euthanasia"
http://www.vmtrc.ucdavis.edu/laboratories/DFSL/euth/euth.html

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U.S. Department of Agriculture, Animal and Plant Health Inspection Service
Animal Health: National Veterinary Stockpile (NVS)
http://www.aphis.usda.gov/animal_health/emergency_management/nvs.shtml

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Subject: Depopulation, Disposal, and Decontamination (3D) Commercial Services
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20. PHOTO AND ILLUSTRATION CREDITS

Page 1 NVRT team strategizing and organizing emergency response events. Photo source: Reneé Dewell, Iowa State University

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(Bottom) Appropriate aiming point for captive bolt or gunshot euthanasia in a cervid. Photo source: JK Shearer, Iowa State University

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Glossary

Air Embolism
An artery blockage resulting from the injection of air into the vasculature. Air embolism is not recommended as a method of euthanasia.

Bovine
Common domestic cattle and other members of the Family Bovidae.

Caprine
Pertaining to goats, members of the Family Capridae.

Cervical Dislocation
A method of euthanasia in which the spinal cord is severed by dislocation of cervical vertebrae.

Contact Premises
Premises that have been determined to be related by sound epidemiological evidence to a known infected premises, also referred to as an exposed premises.

Decapitation
Removal of the head.

Equine
Member of the horse family.

Euthanasia
The deliberate ending of an animal's life in a manner that causes minimal pain and distress.

Euthanize
The act of performing euthanasia.

Exotic
Not native or indigenous to a country.

Exposed Premises
Premises that have been determined to be related by sound epidemiological evidence to a known infected premises, also referred to as contact premises.

Exsanguination
The process of draining or losing blood as a result of internal or external hemorrhage.

Hypovolemia
A decreased amount of circulating blood.

Hypoxia
Diminished availability of oxygen to bodily tissues.

Inhalant
Taken into the body through the respiratory system.

Medial Canthus
Point or angle of eye closest to midline.

Ovine
Pertaining to sheep and other members of the Family Ovidae.

Penetrating Captive Bolt
A firearm used for euthanasia in which a rod that is a permanent part of the weapon is driven through the skull, damaging the brain.

Pithing
Destruction of the brain and upper spinal cord.

Poll
The top of an animal's head or occiput.

Surgical Anesthesia
A state in which the animal feels no painful sensation (9 CFR 313).

Thoracotomy
Incision into pleural space of thorax.

Venipuncture
Surgical puncture of a vein (e.g., for blood withdrawal or intravenous medication).

Acronyms

AERO
Animal Emergency Response Organization

APEP
Accelerated Pseudorabies Eradication Program

APHIS
Animal and Plant Health Inspection Service

AVIC
Area Veterinarian-in-Charge

AVMA
American Veterinary Medical Association

CDC
Centers for Disease Control and Prevention

CFR
Code of Federal Regulations

EPA
Environmental Protection Agency

FAD
Foreign Animal Disease

FMD
Foot and Mouth Disease

FMJ
Full Metal Jacket

ICS
Incident Command System

IM
Intramuscular

IV
Intravenous

NAHEMS
National Animal Health Emergency Management System

NIOSH
National Institute for Occupational Safety and Health

OSHA
Occupational Safety and Health Administration

PCK
Poultry Cash Killer

PFA
Psychological First Aid

PPE
Personal Protective Equipment

PTSD
Post Traumatic Stress Disorder

TDD
Telecommunications Device for the Deaf

USDA
United States Department of Agriculture

VMO
Veterinary Medical Officer

VS
Veterinary Services; a division of APHIS

APPENDIX A: SOME UNACCEPTABLE AGENTS AND METHODS OF EUTHANASIA

Agent or Method	*Comments*
Air embolism	Air embolism may be accompanied by convulsions, opisthotonos, and vocalization. If used, it should be done only in anesthetized animals.
Blow to the head	Unacceptable for most species.
Burning	Chemical or thermal burning of an animal is not an acceptable method of euthanasia.
Chloral hydrate	Unacceptable in dogs, cats, and small mammals.
Chloroform	Chloroform is a known hepatotoxin and suspected carcinogen and, therefore, is extremely hazardous to personnel.
Cyanide	Cyanide poses an extreme danger to personnel and the manner of death is aesthetically objectionable.
Decompression	Decompression is unacceptable for euthanasia because of numerous disadvantages. 1. Many chambers are designed to produce decompression at a rate 15 to 60 times faster than that recommended as optimum for animals, resulting in pain and distress attributable to expanding gases trapped in body cavities. 2. Immature animals are tolerant of hypoxia, and longer periods of decompression are required before respiration ceases. 3. Accidental recompression, with recovery of injured animals, can occur. 4. Bleeding, vomiting, convulsions, urination, and defecation, which are aesthetically unpleasant, may develop in unconscious animals.
Drowning	Drowning is not a means of euthanasia and is inhumane.
Exsanguination	Because of the anxiety associated with extreme hypovolemia, exsanguination should be done only in sedated, stunned, or anesthetized animals.
Formalin	Direct immersion of an animal into formalin, as a means of euthanasia, is inhumane.
Household products and solvents	Acetone, quaternary compounds (including CCl4), laxatives, clove oil, dimethylketone, quaternary ammonium products*, antacids, and other commercial and household products or solvents are not acceptable agents for euthanasia.
Hypothermia	Hypothermia is not an appropriate method of euthanasia.
Neuromuscular blocking agents (nicotine, magnesium sulfate, potassium chloride, all curariform agents)	When used alone, these drugs all cause respiratory arrest before loss of consciousness, so the animal may perceive pain and distress after it is immobilized.

Used with permission from:
American Veterinary Medical Association. Panel on Euthanasia.
AVMA Guidelines on Euthanasia 2007
American Veterinary Medical Association, Schaumburg, IL
Accessed July 27, 2010 at www.avma.org/issues/animal_welfare/euthanasia.pdf

SOME UNACCEPTABLE AGENTS AND METHODS OF EUTHANASIA (CONT'D)

Agent or Method	*Comments*
Rapid freezing	Rapid freezing as a sole means of euthanasia is not considered to be humane. If used, animals should be anesthetized prior to freezing.
Smothering	Smothering of chicks or poults in bags or containers is not acceptable.
Strychnine	Strychnine causes violent convulsions and painful muscle contractions.
Stunning	Stunning may render an animal unconscious, but it is not a method of euthanasia (except for neonatal animals with thin craniums). If used, it must be immediately followed by a method that ensures death.
Tricaine methane sulfonate (TMS, MS 222)	Should not be used for euthanasia of animals intended as food.
*Roccal D Plus, Pharmacia & Upjohn, Kalamazoo, Michigan	

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AVMA Guidelines on Euthanasia 2007
American Veterinary Medical Association, Schaumburg, IL
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APPENDIX B: VETERINARY SERVICES MEMO 583.1

United States Department of Agriculture

Animal and Plant Health Inspection Service

Veterinary Services

Washington, DC 20250

June 17, 2005

VETERINARY SERVICES MEMORANDUM NO. 583.1

Subject: Registration and Use of Drug Enforcement Administration (DEA) Schedule II, III, IV, and V Controlled Substances

To: VS Management Team
Area Veterinarians in Charge, VS
State Veterinarians

I. PURPOSE

This memorandum revises the policy for Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) veterinarians to procure, store, dispense, and administer DEA Schedule II, III, IV, and V controlled substances.

II. CANCELLATION

VS Memorandum No. 583.1, dated September 27, 1994, is hereby canceled.

III. GENERAL

As part of their normal duties, VS veterinarians may need to procure, store, dispense, and administer DEA Schedule II, III, IV, and V controlled substances. The DEA has agreed to allow VS to designate one VS veterinarian (possessing a valid DEA controlled substance registration) per Area to serve as the veterinarian responsible for procuring, storing, and dispensing DEA Schedule II, III, IV, and V controlled substances to VS veterinarians, including himself or herself, in that Area. The VS Area Veterinarian in Charge (AVIC) will designate a veterinarian possessing a valid veterinary practitioner's license for any State in the United States, the District of Columbia, Puerto Rico, or the U.S. Virgin Islands to be responsible for the DEA controlled substances in that Area.

IV. SPECIFIC INSTRUCTIONS

A. Application and Reimbursement

A new applicant designated as the veterinarian in the respective Area responsible for controlled substances will complete the DEA Office of Diversion Control Web Interactive registration application, Form 224, at https://www.deadiversion.usdoj.gov/webforms/app224Login.jsp.

Safeguarding American Agriculture
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A renewal applicant designated as the veterinarian in the respective area responsible for controlled substances must complete the DEA Office of Diversion Control Web Interactive registration application, Form 224a, at https://www.deadiversion.usdoj.gov/webforms/rnw224aLogin.jsp.

VS will reimburse the veterinarian responsible for controlled substances for all costs relative to the application and maintenance of a DEA controlled substances registration. For example, reimbursement will include DEA controlled substances application and registration fees, State veterinary license fees, and fees for training and continuing education necessary to obtain and maintain a single license to practice veterinary medicine in the United States. The supervisor of the designated veterinarian responsible for controlled substances may grant administrative time to the designated veterinarian for official activities related to procuring and maintaining a license to practice veterinary medicine in the United States and for DEA controlled substances registration.

B. Use and Control of Schedule II-V Controlled Substances

1. The designated veterinarian responsible for controlled substances will use the DEA controlled substances registration number only to order euthanasia solutions (unless otherwise directed by the Deputy Administrator of VS).

2. The designated veterinarian responsible for controlled substances will dispense controlled substances only to VS Area veterinarians for use only in an official capacity and only for official purposes.

3. The designated veterinarian responsible for controlled substances will order, receive, store, and dispense all controlled substances.

4. The designated veterinarian responsible for controlled substances will maintain a record of purchases and dispensations of controlled substances. An example of a form that could be used for this purpose, entitled "Narcotic and Controlled Drug Record," is attached (Attachment 1).

5. The designated veterinarian responsible for controlled substances will record, on the VS Form 12-25, the following information for all controlled substances dispensed to veterinarians: product name, manufacturer, serial number, expiration date, purchase date, quantity dispensed, and intended use.

6. The designated veterinarian responsible for controlled substances will keep only the minimum quantity of controlled substances estimated for use in 1 month.

7. The designated veterinarian for controlled substances will provide controlled substances to field veterinarians in an amount not to exceed the estimated quantity for use over a 2-week period.

8. The field veterinarian that receives controlled substances will maintain a log of all controlled substances received from the designated veterinarian responsible for controlled substances stored, and the date, amount, premises location, and reason for the controlled substance's administration. An example of a form that could be used for this purpose, entitled "Log of Controlled Drug Dispensed," is attached (Attachment 2).

9. The designated veterinarian responsible for controlled substances will receive the field veterinarian's controlled substances log prior to dispensing any additional controlled substances to the field veterinarian.

10. The designated veterinarian responsible for controlled substances and the field veterinarian will store controlled substances in a securely locked, substantially constructed cabinet. The combination number or duplicate key for the locked cabinet will be kept with the supervisor of the veterinarian storing the controlled substances.

11. The designated veterinarian responsible for controlled substances and all field veterinarians will dispose of all needles, syringes, and other necessary equipment used to dispense controlled substances, according to current Government regulations and biohazard guidelines.

12. The immediate supervisor of the VS veterinarian responsible for controlled substances will notify DEA in writing within 30 days of transfer or retirement of the responsible veterinarian. This notification should be sent to Office of Diversion Control, Chief, Liaison and Policy Section, 600 Army Navy Drive, Arlington, Virginia 22202. The telephone number for this office is (202) 307-7297.

John R. Clifford
Deputy Administrator
Veterinary Services

Attachments
Attachment 1 – Sample form, Narcotic and Controlled Drug Record
Attachment 2 – Sample form, Log of Controlled Drug Dispensed

NARCOTIC AND CONTROLLED DRUG RECORD

DATE OF PURCHASE

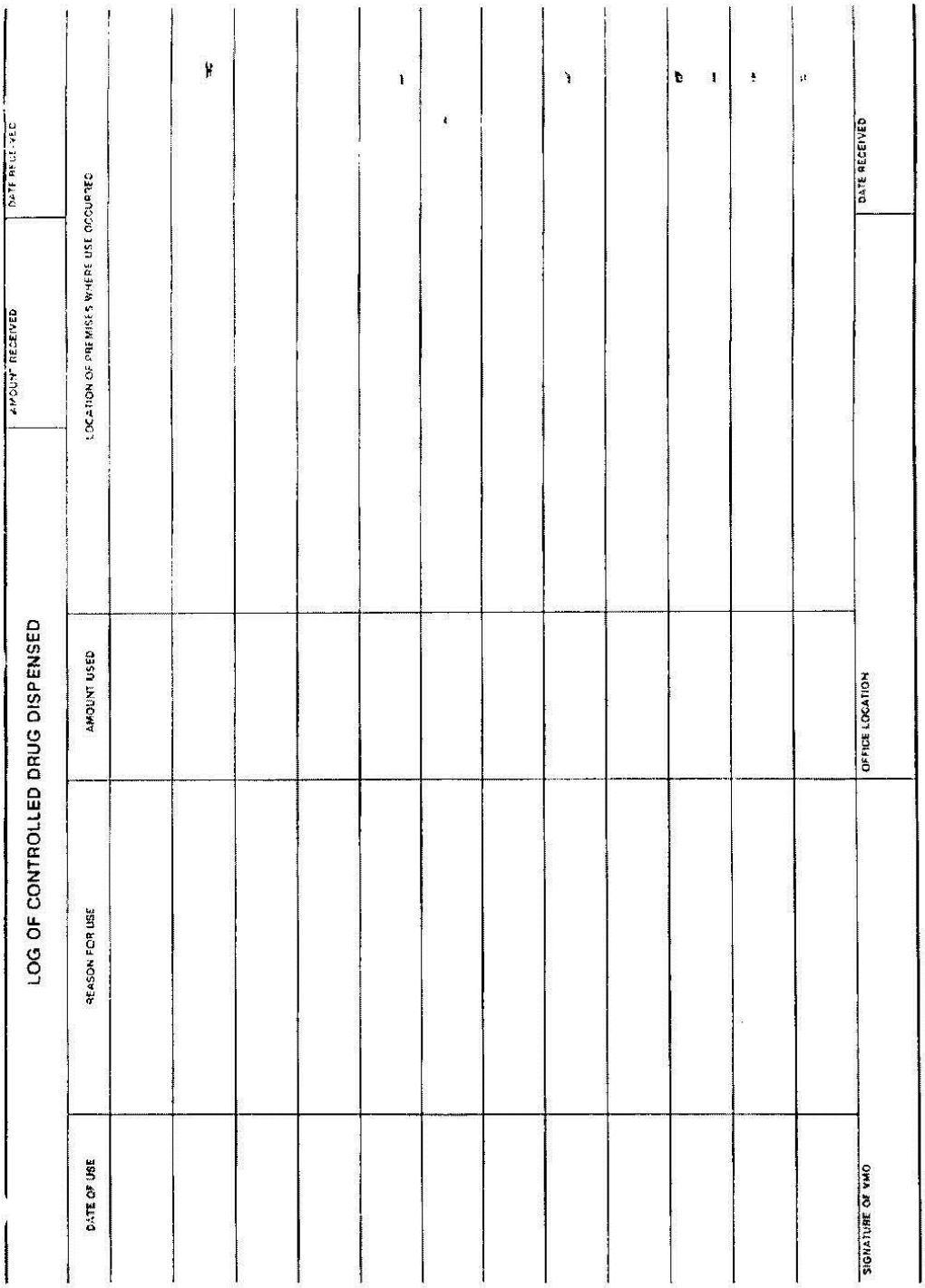
MANUFACTURER	SERIAL NUMBER	EXPIRATION DATE	QUANTITY

RECORD OF DISPENSING

NAME OF VMO	DATE	SERIAL NUMBER	QUANTITY DISPENSED	REASON FOR USE

SIGNATURE OF AREA VETERINARIAN IN CHARGE | DATE SIGNED

VS FORM 12-25
(DRAFT)



LOG OF CONTROLLED DRUG DISPENSED

AMOUNT RECEIVED | DATE RECEIVED

DATE OF USE	REASON FOR USE	AMOUNT USED	LOCATION OF PREMISES WHERE USE OCCURRED

SIGNATURE OF VMO | OFFICE LOCATION | DATE RECEIVED

VS FORM 12-24
(DRAFT)