VMAT DECONTAMINATION
STANDARD OPERATING PROCEDURE

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OPERATING GUIDELINES

- The following guidelines are to be used by the Veterinary Medical Assistance Teams (VMAT). These are basic procedures that may need to be modified depending on the nature of a specific mission involving decontamination of animals.
- Safety of personnel will be of greatest importance in all decontamination missions. The goal is to protect the public, animals, property, and the environment without becoming part of the problem.
- This document shall be reviewed and updated as needed, with dates reflecting the time of any changes.

VMAT DECONTAMINATION TEAM ORGANIZATION

- VMAT Decontamination (DECON) Team
  - The VMAT DECON team will function as a unit of VMAT when a mission involving the decontamination of animals has been identified. The team will be composed of VMAT team members that have met all required selection and training requirements.
- VMAT DECON Team Mission
  - The VMAT DECON Team mission shall be to address animal issues following the release or potential release of hazardous chemical, biological, or radioactive agents. Actions will include animal assessment to be followed by animal decontamination or alternative measures as dictated by the specific incident and/or agent(s) involved.
- VMAT DECON Team Participation
  - VMAT team members who wish to be part of a VMAT DECON team shall make their request to the team Safety Officer and Training Officer. These individuals will determine if individual team members meet the appropriate criteria for VMAT DECON team participation, including the completion of required training. VMAT DECON team members should be encouraged to routinely participate in training exercises specific to the potential demands of an animal decontamination mission.
- Program Administrator
  - The Safety Officer will be directly responsible for the activities of the VMAT DECON team.
- VMAT DECON Team Leader
  - The VMAT DECON Team Leader should be an experienced person who has completed appropriate Hazardous Materials and Incident Command training. He/she will direct activities of the VMAT DECON team at the incident scene unless otherwise relieved. He/she should also supervise assigned VMAT DECON training activities.

DECONTAMINATION TEAM RESPONSE GUIDELINES

- Staffing the VMAT DECON Unit
  - When an animal decontamination mission is needed, members of the VMAT DECON team will be notified and directed to respond to a designated location and prepare their equipment. There they will report to the Incident Commander or other Command Authority to receive their assignment.
- Response Levels
  - Level I Incident
    - Incidents that can be effectively managed and mitigated by first response units without a DECON or other special unit. The incident is not an immediate threat to life. Evacuation is limited to the immediate area and/or involved structure(s) only.

    1- Spills that can be properly and effectively contained and/or abated by equipment and supplies immediately accessible to safety staff.

    2- Leaks and ruptures that can be controlled using equipment and supplies immediately available to the safety staff and/or fire department.

    3- Fires involving toxic materials that can be extinguished and cleaned up with resources immediately available to fire department.

    - May include chemical agents such as arsenical insecticides, rodenticides, riot control agents, and paraquat.
    - Food safety threats (*Salmonella* spp., *E. coli* O57:H7, *Clostridium perfringens* ε toxin)
    - Ricin toxin (from *Ricinus communis*)
    - Dirty bomb (depending on location and strength of explosion)
  - Level II Incident
    - Level II incidents require the special technical assistance of HAZ-MAT DECON, specialist, or facility response team. This incident involves a greater hazard or potential threat to life and may require limited evacuation of the surrounding area.

    1- Spills that can properly and effectively be contained and/or abated by specialized equipment and supplies immediately available to the HAZ-MAT team. Examples are any of the chemical agents in small amounts or the chemical agents covering small areas.

    2- Leaks or ruptures that can be controlled using specialized equipment and supplies immediately available to the HAZ-MAT DECON team.

    3- Fires involving toxic and/or flammable materials that are permitted to burn with the contract fire department standing by.

    4- HAZ-MAT incidents where specialized technical information is required.

    5- HAZ-MAT incidents that can be contained and controlled using the available resources of the DECON team, and /or other specially trained unit.

    - Water safety threats (*Cryptosporidium parvum, Vibrio cholerae*)
    - Viral encephalidities (Western equine encephalitis, Eastern equine encephalitis, Venezuelan equine encephalitis)
    - Melioidosis (Burkholderia pseudomallei)
    - Dirty bomb (depending on location and strength of explosion) or nuclear power plant accident (with limited release of radioactive material)
  - Level III Incident

    1- The incident may require the resources of local, county, state federal and private agencies.

    2- Spills that cannot be properly and effectively contained and /or abated by specialized equipment and supplies immediately accessible to the DECON team.

    3- Leaks and ruptures that cannot be controlled using specialized equipment and supplies immediately available to the DECON team.

    4- Fires involving toxic materials that are allowed to burn because water is ineffective or dangerous, or because there is potential of large container failure, or because a large explosion.

    - Incidents that are major disasters that pose a severe hazard or threat to life and property, and require large scale evacuation. Examples are any of the chemical agents in large amounts or if the chemical agents are covering large areas.
    - Nipah virus

        - Anthrax (*Bacillus anthracis*)
        - Plague (*Yersinia pestis)*
        - Viral Hemorrhagic Fevers (Ebola virus, MarburgVirus)
        - Botulinum toxin (*Clostridium botulinum)*
        - Staphylococcal enterotoxin B
        - Hantavirus
        - Tularemia (*Francisella tularensis)*
        - Brucellosis *(Brucella* spp.)
        - Glanders (*Burkholderia mallei*)
        - Q fever (*Coxiella burnetti)*
        - Typhus (*Rickettisa prowazekii*)
        - Psittacosis (*Chlamydia psittaci*)
        - Smallpox (Variola virus)
        - Transmissible animal diseases that may also qualify as a major emergency:
            - Foot and mouth disease
            - Swine vesicular disease
            - Peste des petits ruminants
            - Lumpy skin disease
            - Bluetongue
            - African horse sickness
            - Classical swine fever
            - Newcastle disease
            - Vesicular stomatitis
            - Rinderpest
            - Contagious bovine pleuropneumonia
            - Rift Valley fever
            - Sheep pox and goat pox
            - African swine fever
            - Highly pathogenic avian influenza
        - Nuclear Explosion or nuclear power plant accident (depending on amount of released material, e.g, total containment failure)
- Dispatching VMAT DECON Team
    - Level I Incident
        - Either a partial or full VMAT DECON team may be needed
    - Level II and Level III Incidents
        - All Safety personnel and VMAT DECON team members will be needed
    - Method of Notification and Dispatch

INITIAL INCIDENT ASSESSMENT

- Purpose
    - The first units on the scene of most hazardous materials incidents may be fire/police services or other agencies with varying degrees of training. Because of this, the initial assessment may vary greatly. Therefore, the VMAT team will need to re-evaluate the data received from these agencies and conduct an independent assessment of each incident as needed.
- Rationale
    - Because each incident poses unique challenges, an initial assessment is essential in order to reduce the potential for injury to responders, minimize injury to animals, and minimize spread of hazardous materials through animal movements.
- Initial Precautions
    - The following initial precautions shall be taken by all personnel before response to, and arrival at, the scene:

    1. PPE in ready condition and accessible
    2. Animal restraint equipment (halters, leashes, tranquilizers, crates/cages, etc) accessible

3. Note location of available animal containment areas in Hot and Cold Zones
4. Briefing on Zone locations and size, command post location, staging, etc.
5. Incident assignments made
6. Note wind direction and speed
7. Note water flow direction
8. Approach scene from up-hill/up-wind/up-stream
9. Stop apparatus at a safe distance from incident

- NOTE: In no case should the approach be closer than 500' before initiating assessment process
- Human safety must be assured before animal risks can be addressed
- Animal owners may be anxious to help and/or return to the incident area to retrieve their animals, therefore adequate security must be available to prevent unauthorized entry into the incident area.
- In cases involving animal species that require specialized handling (e.g. exotic/wild animals) to minimize injury to both human and animals consultation with those with expertise on those species is highly desirable.
- Entry of such experts into the incident area should be restricted.

- Status of the Animals
  - Accessibility to animals
    - Free-ranging animals will need to be moved to single containment area
    - Animals in buildings, cages, vehicles etc. may need to be evacuated to a single containment area if remaining in the original area will increase exposure to hazardous agent(s)
    - Structures should be assessed to determine potential for human exposure and PPE utilized as needed
    - In cases where accessibility issues make removal for decontamination impossible, euthanasia may be considered if animals are at high risk for injury, dehydration, starvation, etc.
  - Financial considerations
    - Finances may be an issue, especially when involving production animals
    - If exposure results in animals that will not be marketable (e.g. due to residue issues), consultation with animal owners/producers is indicated to determine course of action
    - Some situations may dictate euthanasia of currently healthy animals rather than decontamination (e.g. cost of decontamination exceeds market value of animals)
  - Dead animals
    - Due to the various potential hazardous agents that may be involved, consultation with environmental authorities will be required to determine whether decontamination and/or removal of animal carcasses are required.
    - Decontamination of carcasses should only be instituted after all live animals have been decontaminated
    - Carcasses remaining in the incident area must be burned or buried deeply to reduce the risks to scavenging animals
    - Animals euthanized with barbiturate euthanasia solutions pose significant risk of barbiturate toxicosis to scavengers feeding on the carcasses; therefore these carcasses should be removed or deeply buried
    - Federal legal action can be taken against veterinarians, animal owners and others in cases where protected species, such as eagles, are killed as a result of feeding on euthanized carcasses that have been inadequately disposed of
  - Injured/ill animals
    - Ill or injured animals will need to be provided with adequate veterinary care prior to, during, and after decontamination
    - Triage should be performed to identify those with mild, moderate, and major injury/illness
    - Animals should be stabilized prior to decontamination
    - Euthanasia should be considered for animals deemed too severely affected to withstand the stress of decontamination
    - In incidents where large numbers of animals are involved, treatment should be reserved for those animals deemed most likely to survive, while those with life-threatening conditions should be euthanized for humane reasons

        - Arrangements should be made for follow up veterinary care off-site after decontamination
    - Healthy animals
        - Healthy animals will require supportive care following decontamination
        - Arrangements must be made to adequately feed, house and manage healthy animals following decontamination
    - Density/number of animals
        - Commingling of large numbers of animals may increase the potential for outbreaks of infectious disease and traumatic injuries due to fighting or crowding
        - Depending on species, territorial aggression may result in animals being injured or deprived of food and/or water by dominant animals
        - Commingling of different species is undesirable and should be avoided if at all possible
        - Dead animals should be removed from containment areas as soon as possible to prevent cannibalism or spread of infectious disease
- Determining if Hazardous Agents are Present
    - Responders shall be aware of the following indicators when assessing the potential presence of hazardous materials (maintain safe distance when making assessment):
    1. Type of occupancy
    2. Information from bystanders, employees, drivers
    3. What is happening at the incident
    4. Types of containers
    5. Placards
    6. Labels
    7. Way bills and bills of lading (inside the cab, driver's side)
- Isolate and Deny Entry
    - The commander shall keep the public, animals and emergency personnel at a safe distance (as far as 10 miles away from the contaminated area).
    - The commander shall keep the public, animals and emergency personnel upwind side, considering the potential change of wind directions.
    - VMAT should use the following methods of isolation:
    1- Barrier ribbon.
    2- Road cones.
    3- Block entry with apparatus.
- Identify Hazardous Agent
    - When it is determined that a known or suspected hazardous material is present, the incident commander and/or safety officer shall attempt to identify the material using one of more of the following methods:
    1- Use the information available (placards, labels, bills of lading, waybills, consist, wheel reports)
    2- Asked the owner, site specialist, or employee
    3- Contact shipper.
    4- Contact the manufacturer
    5- Call CHEMTREC (you need to identify as much information as possible including train or truck number and/or the manufacture's name)
- Assess the Potential
    - The on site incident commander shall assess the potential danger by estimating the amount of hazardous material that may be released at what rate, where it will go, and what its effects will be.
    - The commander shall assess the type of chemical agent and the expected severity of signs associated with the agent.
    - This information will help determine the need for evacuation, the area to be evacuated, and what resources will be needed. The commander should use the following methods to assess the potential:
    1- Container size and the amount of the material inside. Large amounts can cause severe and rapid effects in animals, and at the same time will be a challenge to contain. A small amount of chemical agent can be contained fairly easily and the hazards will be minimal.
    2- Type of hazardous material. Nerve agents/cholinesterase inhibitors are an example of agents that can rapidly cause severe signs in animals.

3- Damage to the container and amount of material leaking.
4- Weather conditions. Dry windy weather will allow chemical agents to spread more quickly and effectively, while rainy weather will help limit the spreading of the agent.
5- Geographical location and demographics of the area where incident has occurred. Always move the animals from the downhill side to the uphill side.
6- Is fire involved? Fire can produce toxic fumes and animals should be quickly moved to the upwind side.
7- Is the hazardous material migrating by runoff or vapor cloud? Can occur with nerve agents.
8- Are there any contributing factors such as age and health status of the animals, species of animals involved, time between the actual exposure and when decontamination and treatment are initiated.

- With radiation, Contaminated animals pose a limited danger since increasing distance from a radioactive source decreases potential exposure.

- Call for Assistance
  - The Incident Commander/Director may determine that additional help is needed. Assistance can come from both emergency and non-emergency organizations. The need for assistance can be associated with requirements for additional manpower, equipment and technical experts. Resources may come from the following areas and/or organizations:

a) Local animal control authorities (animal restraint, containment)
b) Police (crowd control, access restriction)
c) USDA (food animal issues)
d) EPA (environmental issues, carcass disposal)
e) US Army Veterinary Corps SMART-V (primary veterinary care, evacuation planning)
f) Local veterinarians (medical supplies, restraint apparatus)
g) State veterinarian's office
h) Public health department (equipment, dirt, sand, road barricades)
i) Local or federal wildlife officials (environmental issues, wildlife management)
j) Local zoos (animal handling advice, specialized capture apparatus)
k) Humane organizations (Emergency Animal Rescue Programs, ERPs) (food donations, crates, caretakers)
l) United Animal Nations (trained volunteers for animal disasters)

- Defensive Tactical Consideration
  - Rescue
    - Rescue can only be successful if it can be accomplished without creating more victims.
    - Any animal that has been rescued should be considered contaminated until determined otherwise.
    - Animals should be handled with care to prevent contamination of emergency personnel.

1. Attempt rescue only if you have the proper level of personal protective equipment (PPE).
2. Work in groups or at least in pairs.
3. Have a back up team if possible and/or use lifelines.
4. Be prepared to decontaminate the VMAT personnel involved.

  - Confinement (See Appendix 1)
  - Eliminating/Neutralizing the Hazardous Agent
    - Flushing or flooding contaminated skin with water or aqueous solutions can remove or dilute significant amounts of the agent. When animal skin contaminated with GB was flushed with water (a method in which physical removal predominates over hydrolysis of the agent), 10.6 times more GB was required to produce the same mortality rate compared to when no decontamination occurred. In another study, the use of water alone produced better results than high concentrations of hypochlorite (i.e., 5% or greater, which is not recommended for skin). Timely copious flushing with water physically removes the agent and will produce good results.
    - It is necessary to control run-off; know where the water is going.
    - Scraping with a wooden stick, i.e., a tongue depressor or popsicle stick can be used to physically remove bulky agents.
    - Radiation cannot be neutralized but may potentially be removed via decontamination.

- Protect in Place
  - This will depend on the type, amount, and severity of chemical agents involved in an attack or spill. If the chemical agent is highly toxic, and present in large amounts, movement of animals out of the area is highly recommended.
  - If the chemical agent is not highly toxic, or there is only a small amount of contamination, decontamination in place may be appropriate because the risks will be minimal to VMAT personnel and the potential hazard of repeated contamination from the area itself will also be low.
  - This will also depend on weather conditions and animals' position (downwind or upwind, uphill or downhill).
  - With radiation, decontamination in place would be preferable to decrease the risk of contaminating new areas.
- Evacuation
  - Will depend on how many animals are affected and the severity of the situation.
- Resources necessary for evacuation
  1. Time
  2. Personnel
  3. Shelters for evacuated animals
  4. Food and water, sanitation resources and housing ares for evacuated animals
  5. Transportation – species-appropriate animal carriers, vehicles, etc.
  6. Police assistance
  7. Assistance from other departments or agencies
  8. Communications

MANAGEMENT AND CONTROL

- Purpose
  - To provide criteria for scene control specific to incidents involving animals potentially contaminated with chemical, biological, and/or radiological agents.
- Incident Command Structure
  - The VMAT DECON team will function under the National Fire Service's Incident Management System.
- Command Post
  - A command post will be established at the scene prior to the arrival of the VMAT DECON team.
  - The location will be uphill, upwind, upstream, and a safe distance from the incident.
- Duties and Responsibilities
  - Incident Commander
    - Establish command and control structure
    - Under advisement of the VMAT DECON Team Commander, establish the initial hot zone
    - Establish the initial cold zone
    - Reevaluate control zones and operational objectives
    - The Safety Officer will have the authority to stop any and all unsafe actions
  - Safety Officer
    - Duties as per ICS
    - Prepare a Site Safety Plan
    - Ensure that all elements of safety are adhered to
    - Monitor activities in control zones and observe for hazards that may require the modification or termination of operations
  - Operations
    - Duties as per ICS
  - VMAT DECON Team Commander
    - Contact Incident Commander upon arrival and receive briefing
    - Assist IC with hazard assessment
    - Determine agent/product identification
    - Make necessary agency notifications and request resources and/or assistance as needed

    - Determine the actions necessary to protect people, animals, property, and the environment
    - Make assignments and advise the IC of specific needs
    - Receive feedback from the Safety Officer, medical officers, and other team members
    - Supervise control/cleanup operations
    - Remain on-scene until incident has been stabilized
    - Assure that all reports and documentation are properly completed
    - Supervise replacement of the VMAT DECON equipment
- Incident Recorder/Communications Officer
    - Receive instructions from the VMAT DECON Team Commander
    - Report to IC
    - Maintain an Incident Log, recording information in chronological order with the times/dates of all significant actions, occurrences, conversations, decisions, etc.
- Entry Team Leader
    - Maintain contact with VMAT DECON Team Commander and DECON officers
    - Select Entry Team preparation site
    - Ensure that Entry Team(s) and Back-up Team(s) are properly equipped and dressed for the potential agents they will encounter
    - Establish an entry location into the hot zone and control access
    - Establish an emergency egress corridor
    - Maintain contact with Entry Team(s) while they are in the hot zone
    - Record and log the movement of personnel into and out of the hot zone
    - Record and log equipment used in the hot zone
- Entry and Back-up Team(s)
    - As directed, don appropriate clothing and equipment
    - Performs operational activities as directed by the Entry Team Leader and IC
- Entry Team Assistant
    - One assistant to each two-person Entry Team
    - Assists in the donning of protective clothing
    - See that both members of the Entry Team go on SCBA at the same time
    - Records baseline data, entry time, and exposure data
    - Provides continuous visual and radio monitoring of the Entry Team
    - Notifies Entry Team when they have exhausted their work time and directs their withdrawal; notifies Entry Team Leader of the same
    - Observes for hazards that may modify or terminate operations
    - Follows progress of Entry Team through decontamination
- DECON Officer
    - Maintains contact with VMAT DECON Team Commander and Entry Team(s)
    - Determines appropriate decontamination measures
    - Determines best site for the decontamination unit
    - Closely supervises the set up and operation of the decontamination unit and frequently checks the effectiveness of procedures
    - Notifies VMAT DECON Team Commander and Entry Team Leader the decontamination unit is operational
    - Ensures that all personnel leaving the hot zone are decontaminated
    - Ensures that VMAT DECON team members decontaminate themselves
    - Ensures that decontamination equipment is decontaminated or disposed of and that decontamination solutions are contained for later disposal
- DECON Team Member
    - Under the direction of the DECON Officer, assists in the setup of the decontamination unit
    - As directed, dons appropriate protective clothing and equipment
    - Performs decontamination functions as directed by the DECON Officer
    - Assists in closing the decontamination unit

- Site Control
  - To control operational activities, minimize the transfer of hazardous materials from the incident site, and for the safety of all personnel in the area.
  - Site Control
    - Barriers to exclude unnecessary personnel
    - Minimize the number of VMAT DECON team members needed for decontamination unit operations
    - Establish work zones and limit entry to essential personnel only
    - Control points to control access
    - Decontamination
  - Control Zones
    - Control zones shall be established for all decontamination missions. Access shall be limited by control points. The incident site shall be divided into three control zones: hot zone, warm zone, cold zone.
    - Hot Zone
      - This is the innermost of the three areas, and where contamination could occur. All personnel entering this zone shall wear appropriate levels of protection. An access control point shall be established to regulate entry, and personnel should be briefed on the location of the emergency exit corridor. Boundary lines shall be well-defined and established by one or more of the following methods:
        - Visually surveying the area
        - Air sampling
        - Information from references
        - Need to prevent fire
        - Potential for airborne contaminants
    - Warm Zone
      - The warm zone is where the decontamination unit is located and it provides a transition between the contaminated and clean areas. All personnel exiting the hot zone shall go through the decontamination unit. All personnel entering this zone shall wear appropriate levels of protective equipment. An access point shall be established to control entry and exiting personnel. The boundary line shall be well defined.
    - Cold Zone
      - The cold zone is the outermost part of the operation area at the incident site and considered a clean area. The Command Post may be located here along with support personnel and equipment. This zone is restricted to authorized personnel only.

HAZARD RECOGNITION AND IDENTIFICATION

- Purpose
  - Describe procedures and considerations the VMAT team shall use in the recognition and identification of a hazardous material.
- Rationale
  - Recognizing the presence of hazardous agents and then identifying them will determine all subsequent actions of the VMAT DECON team.
- Determining if Hazardous Agents are Present
  - The following indicators may be helpful when assessing a scene for the potential presence of hazardous agents. This assessment should be made from a safe distance.
    - Type of area/structure
    - Information from emergency personnel, bystanders, human victims
    - What is happening at the incident scene
    - Types of containers/debris at the scene
    - Placards
    - Labels
    - Waybills and bills of lading inside the cab of trucks

- Action Items Upon Arrival
  - Establish a Command Post and staging areas away from the scene on the uphill/upwind side.
  - Stay well away from spills or wet areas; park uphill/upwind.
  - If a vapor release is suspected, stay away. The invisible cloud is usually much larger than the visible cloud.
  - If no obvious spill or cloud is present, observe the animals or people at the incident scene. If people or animals are ill or unconscious, stay away until enough information is available to properly protect yourself.
  - Always enter an incident site slowly to avoid getting in too deeply before knowing as much as possible about the situation.
  - If necessary, stop well back from the scene and send a single Entry Team in a minimum of Level B PPE and equipment to check the situation. Entry should not be made until the decontamination unit is operational.
  - If it cannot be determined what agent is involved, treat it as highly toxic, violently reactive, and highly explosive.
- Identify Hazardous Agent
  - Types of chemical agents
    - Nerve agents such as GA (tabun), GB (sarin), GD (soman), GF, and VX.
    - Vesicants or blister agents such as mustard.
    - Cyanide.
    - Incapacitating agents such as BZ, and riot-control agents (similar to MACE).
    - Lung-damaging (pulmonary) agents such as phosgene.
    - Arsenical insecticides
    - Methylmercury and inorganic mercurials
    - Rodenticides
    - Fumigants and paraquat
    - Hydrocarbons
    - Gases
    - Solvents
  - Places to search for information on individual diseases
    - http://www.cdc.gov/ncidod/dpd/parasiticpathways/animals.htm#Top
    - http://www.cfsan.fda.gov/~mow/intro.html
    - http://www.cfsan.fda.gov/~dms/fsterr.html
  - Will need to use real-time radiation detection devices to assess presence of radioactive compounds

HAZARD AND RISK ANALYSIS

- Purpose
  - To gather and review available information about the agent(s) involved and other factors that may have an impact on the specific situation and therefore the actions of the VMAT DECON team.
- Hazardous Agents Analysis
  - After the hazardous material has been identified, as much information as possible about the hazardous material and its physical properties shall be collected. Sources of information include, but are not limited to:

1. Container labels
2. Materials safety data sheets (MSDS)
3. DOT emergency response guidebook
4. OSHA/NIOSH pocket guide to chemical hazards
5. CHRIS manual. (Chemical Hazards Response Information System)
6. Hygienic guide series
7. Determination of TLV'S (ACGIH)
8. Emergency handling of HazMats in Surface Transportation (Bureau of Explosives)
9. Firefighters handbook of hazardous materials
10. EIS or CAMEO computer systems
11. CHEMTREC

12. Manufacturer
- Radiation
  - www.nrc.gov (Nuclear Regulatory Commission)
  - *Medical Management of Radiological Casualties* and other resources at http://www.afrri.usuhs.mil/ (Armed Forces Radiobiology Research Institute)

- Incident Event Sequence Analysis
  - The IC shall conduct an events analysis to define the following:

1. Identify the nature and extent of the incident
2. Identify who or what is involved
3. Determine what is happening now
4. Determine what is likely to happen (probabilities and possibilities)

- Analyze Courses of Action
  - The IC shall identify incident response actions. All practical options shall be considered before action is taken. When strategic objectives have been identified, they will be weighed against the available resources. Such things as response times, personnel, specialized equipment and technical expertise shall be considered.
  - Priority for direct involvement shall be based on:
  - People
    - Are people exposed to risk?
    - Can people exposed to risk be safely removed from the danger areas?
    - Will entering danger area in order to remove animals put people in significant danger of being trapped, injured or killed?
    - How can you protect yourself and the animals you hope to rescue from the harmful effects of the hazardous material?
  - Animals
    - What species are involved?
    - How many animals are involved?
    - Are there injured or dead animals involved?
    - Is there adequate veterinary support to triage, stabilize, decontaminate, and provide supportive care?
    - Will direct involvement prevent or reduce risk of injury to animals with minimal risk of harm to yourself?
    - What type of restraint apparatus will be required to contain, capture and/or control the animals?
    - Are there adequate means to contain animals before and after decontamination?
    - Do uncontained animals pose a risk for spreading the contamination zone?
    - What are the potential risks to wildlife and how can these be minimized?
    - Are there adequate supplies to feed, water and provide veterinary care for the animals?
    - Will there be a need to transport animals off of the site? If so, is adequate transportation available?
  - Property
    - Will your direct involvement prevent or reduce damage to exposed property or systems without harm to yourself or others?
  - Environment
    - Can you safely prevent or reduce environmental damage from decontamination procedures?
    - Can you prevent or minimize environmental damage from animal containment apparatus?
    - Can you provide for adequate disposal of animal carcasses in order to prevent wildlife injury?
    - Do you have the proper safety equipment to do the job?
    - Do you have adequate personnel, supplies and equipment to do the job?
    - Do you have the expertise to safely accomplish what needs to be done?

- Select Best Course of Action
  - Information on toxic properties, concentrations, possibility of exposure, routes of exposure, type(s) of animal(s) involved, available resources, possibilities and probabilities will dictate the tactical decisions of the Incident Commander and determine mitigation efforts.

- Possible scenarios
  1- Any terrorist attack with any of the nerve agents as sarin, blister agents as mustard, ricin, or lung–damaging agents such as phosgene.
  2- Any spill incidents of chemical agents as organophosphate or chlorine as in case of a truck accident on any of the highways near any of the large animal farms.
  3- Leaking of chemical agents from an industrial factory to a water stream or to the soil.

EVALUATION AND SELECTION OF PROTECTIVE EQUIPMENT

- Purpose
- To establish procedures for evaluation and selection of protective clothing and equipment when responding to animal decontamination missions
- Personal Protective Equipment (PPE) Guidelines
- PPE shall be selected based on the protection it provides for specific agents to be encountered
- When in doubt, always go to the next higher level of protection
- If it cannot be determined what agent is involved, treat it as highly toxic, violently reactive, and highly explosive
- Selection will take into account:
  - Identification and characteristics of the hazardous agent
  - Potential routes of exposure
  - Resistance and durability of PPE against the specific agent
  - Work requirements and task specific conditions
  - Effects of PPE in relation to heat stress
- Protection Levels
- Level A
  - Should be worn when the highest level of respiratory, skin, and eye protection is required
- Level B
  - Should be worn when the highest level of respiratory protection is required, but a lesser level of skin protection is warranted
- Level C
  - Should be worn only when dealing with nontoxic agents that pose no skin hazard and no contact will occur
- Level D
  - This is a work uniform and offers NO protection
- Selection of Protection Level
  - General considerations:
    - Types and measured concentrations of hazardous agents and their potential toxicity
    - Potential for exposure to other substances in the air, splashes of liquids, or other direct contact with hazardous agents
    - Safety conditions of the incident
  - Considerations when working around animals:
    - Loss of dexterity, risk of injury or animal escape
    - Fear factor due to appearance
    - Risk of injury to gear resulting in human exposure
  - High level protective equipment should be worn if the agent is unknown (expect the worst).
  - Move in groups or at least in pairs in case equipment malfunctions and you need help for yourself.
  - Radio communication should be open at all times between team members so everyone is aware of the location of others.
  - Move slowly; the PPE equipment is heavy and will require extra physical effort to work with/around animals.
  - During the decontamination process, if you are experiencing any of difficulty of breathing, skin irritation, and/or watery eyes, move outside the contaminated area immediately, remove your PPE and check the equipment very carefully.

- **Level A**
- Criteria
  - Use Level A in case of any gaseous type exposure (Remember that some of the gases are colorless and odorless as in case of blistering agents).
  - Responders should use a NIOSH-approved, pressure-demand SCBA in conjunction with a Level A protective suit in responding to a suspected biological incident where any of the following information is unknown or the event is uncontrolled:
    - The type(s) of airborne agent(s).
    - The dissemination method.
    - If dissemination via an aerosol-generating device is still occurring or it has stopped but there is no information on the duration of dissemination, or what the exposure concentration might be.
  - Acceptable for most radioactively contaminated scenes.
- Composition
  - SCBA
  - Fully encapsulated chemical/vapor resistant suit
  - Gloves (inner) – chemical resistant
  - Boots – chemical resistant, steel toe and shank
  - Disposable gloves and boot covers worn over fully encapsulated suit
  - Radio
- **Level B**
- Criteria
  - Methylmercury compounds and inorganic mercurials; riot-control agents.
  - Responders may use a Level B protective suit with an exposed or enclosed NIOSH- approved pressure-demand SCBA if the situation can be defined in which:
    - The suspected biological aerosol is no longer being generated
    - Other conditions may present a splash hazard
  - Appropriate for any radioactively contaminated scene, especially if high likelihood of gaseous radioactive agents.
- Composition
  - SCBA/Full face respirator
  - Chemical resistant clothing/Level B suit – hooded, one or two piece chemical splash suit; disposable chemical resistant, one piece suit
  - Gloves (inner) – chemical resistant
  - Gloves (outer) – chemical resistant
  - Boots (outer) – chemical resistant, steel toe and shank
  - Boot covers (outer) – chemical resistant, disposable
  - Radio
- **Level C**
- Criteria
  - Hydrocarbons, solvents and detergents.
  - Responders may use a full face-piece respirator with a P100 filter or powered air-purifying respirator (PAPR) with high efficiency particulate air (HEPA) filters when it can be determined that:
    - An aerosol-generating device was not used to create high airborne concentration.
    - Dissemination was by a letter or package that can be easily bagged.
    - These types of respirators reduce the user's exposure by a factor of 50 if the user has been properly fit tested.
  - Light radioactive contamination; low chance of gaseous radioactive elements.
- Composition
  - Coveralls/Tyvek suit
  - Helmet with face shield
  - Gloves

    - Radio
- **Level D**
- Criteria
    - Carbamate insecticides and rodenticides
- Composition
    - Uniform or coveralls, and street clothes
- **Inspection of Fully Encapsulated Suit Prior to Donning**
    - Protective clothing shall be properly inspected prior to wearing it
    - Steps for visually inspecting protective clothing
        - Examine fabric and seams for abrasions, cut, holes, or tears
        - Examine seams for separation
        - Examine zippers and other connecting devices for proper sealing and operation
        - Examine for signs of previous damage from incomplete decontamination
        - Examine exhaust valves for proper functioning
        - Examine face pieces for cracks
- **Steps for Donning Fully Encapsulated Suits**
    - These general guidelines may need to be modified for certain suits.
    - A helper will be assigned to assist the wearer into the suit.
    - Wearer will check SCBA prior to donning. Use of encapsulated suits implies that the wearer has thorough knowledge of the SCBA.
    - Suit will be inspected for deficiencies that will hamper its effectiveness.
    - While preferably sitting over the feet of the suit, put on chemical resistant, steel toe and shank boots. If using one piece suits with heavy soled protective feet, wear chemical resistant overboots on the outside of the suit.
    - Don SCBA, disconnect breathing regulator, and put mask on. Depress donning switch and open tank fully.
    - Put on inner gloves.
    - For suits with detachable gloves, secure gloves to sleeves. While standing, put arms into sleeves, then the head into the hood of the suit. The helper should pull suit up over the SCBA, adjusting the suite around the users air pack frame and shoulders. To ease the entry into the suit, the wearer should bend at the knees as the hood is placed over the head. Avoid bending at the waist; this motion tends to use up room in the suit rather than provide slack. It may be easier for a tall person to put on the hood of the suit prior to getting into the sleeves.
    - Put on disposable outer gloves and boot covers.
    - Secure suit by closing all fasteners/zippers until there is only room to connect the breathing regulator.
    - Connect the breathing regulator.
    - When the wearer is breathing properly in SCBA, close the suit.
    - Observe the wearer for a short time to assure that everything is functioning properly.
    - Record the starting time.
- **Steps for Doffing/Removing Fully Encapsulated Suits**
    - These general guidelines may need to be modified for certain suits.
    - Doffing is a step by step process that is integrated into the decontamination procedures.
    - A member of the VMAT DECON team will be needed to assist in the doffing process, and shall take care to prevent cross contamination of the suit wearer. To minimize the chance of cross contamination, VMAT DECON team members should only touch the outside and the wearer should only touch the inside of a suit.
    - Wash suit with specified decontamination solution and rinse suit.
    - Remove outer boots and gloves.
    - Wash suit with specified decontamination solution and rinse with water.
    - Final suit rinse with water.
    - Open suit.
    - Raise hood over head and place on air cylinder.

- Remove arms one at a time.
- Preferably while sitting, remove both legs. Step from the suit and leave.
- Disconnect breathing regulator by depressing donning switch, doff SCBA, and leave.

APPENDIX 1. CONSIDERATIONS FOR WILDLIFE DECONTAMINATION

- Risk Assessment:
  - The decision to decontaminate wildlife should be given careful thought. The risk assessment must consider not just the actual decontamination itself, but the difficult steps preceding and following the wildlife decontamination procedure. Wildlife decontamination entails stalking, capturing, anesthetizing, physically restraining and incarcerating self destructive and combative patients. Numerous significant risks exist to both responders and wildlife.
    1. Likelihood of Wildlife Contamination
       - Unless evidence supports wildlife contamination, more damage may be done by a decontamination attempt than the agent may cause. The potential for wildlife contamination must be evaluated carefully. Ambulatory animals may spread disease divergently to environmental trends (wind direction, watershed). Sampling a survey population may indicate the extent of wildlife contamination.
    2. Likelihood of Adverse Sequelae
       - Several adverse sequelae are possible, but the likelihood varies with each scenario. Animal behavior, contact with domestic animals, potential for biologic amplification and susceptibility to contaminant all influence potential sequelae.
    3. Wildlife Species Involved
       - It is unethical and potentially illegal to euthanize animals based on personal preference or phobias. Equipment and skills required to decontaminate wildlife depend on species affected. The relative risk must consider both the value of individual animals to the population as well as the danger posed by wildlife handling. Immobilization drug selection and dose vary with species.
    4. Safe Wildlife Capture Capacity
       - Appropriate training and equipment must be available to capture wildlife before decontamination is considered. Physical and chemical restraint techniques for wildlife by species are covered in the NDMS Online training programs. Those and other references should be studied and practiced prior to a wildlife emergency.
       - Specific techniques and equipment vary greatly by species. Proper selection are critical to safe success. Remote immobilization equipment should not be used without complete training. Accidental human exposure to immobilization drugs can be lethal. Protocols and antidotes for emergency treatment must be on site.
    5. Safe Wildlife Decontamination Capacity
       - Decontamination equipment must be appropriate for wildlife. Size, shape and texture (scales, skin, hair, feathers, and quills) of wildlife require specialized equipment and techniques. Wildlife demeanor creates exponentially more difficulty. Potential self-trauma and staff injuries are more likely from struggling wildlife. Chemical immobilization may be required not only to capture, but during the decontamination.
    6. Ability to Safely Hold Captive or to Immediately Release Wildlife
       - Before starting a wildlife decontamination mission, the post-decontamination preparations must be complete. Whether to hold wildlife captive or immediately release should be carefully considered. The best choice is release immediately post decontamination. Wildlife release requires that a suitable location exists and transportation equipment is available. Release at the exact point of origin is ideal.
       - However, environmental contamination may preclude wildlife release at the capture location temporarily or permanently. If released near the origin, wildlife will likely return to their own territories. Remote translocation is the last choice, but may be the only viable release alternative.
       - Release may be delayed for several reasons. Chemical immobilization may require recovery time prior to release. Biologic agents may require wildlife quarantine or holding

may be required in lieu of a release location. A complete Wildlife Decontamination Action Plan must also include equipment for holding wildlife if immediate release is impossible.
        - It is illegal to translocate rabies target species (raccoon, skunk, fox, bat, and woodchuck) in rabies endemic states. Healthy rabies target species may still be euthanized or quarantined if they cannot be released at the point of origin post decontamination.
- Potential Contaminated Wildlife Adverse Sequelae:
    - Justification for decontamination of wildlife requires a compelling reason because of the complexity and potential risk to staff. Contaminated wildlife may pose a risk to public and animal health. The probability of at least one of the following potential adverse sequelae must be great enough to justify resource commitment to wildlife decontamination. If none of the following adverse sequelae are likely, wildlife decontamination may be unwarranted or contraindicated.
        1. Dispersal of Contaminates or Pathogens via Wildlife as Mechanical Vectors
            - Although chemical and radiological contaminates cannot be amplified in wildlife, they may be dispersed by wildlife movement. Some contaminants may be concentrated in wildlife by consumption or repeated contact within the hot zone. Wildlife immune to a biologic agent may still disperse the pathogen to susceptible species or humans. Decontamination should be considered if wildlife act as significant mechanical vectors.
        2. Dispersal of Pathogens via Wildlife as Biological Vectors or Reservoirs
            - Species vary in susceptibility to any pathogenic biologic agent. Each bio-contaminant must be considered individually and cross-referenced with the endemic wildlife potential pathogens. A biologic agent incapable of infecting the species in question cannot be amplified or sustained in a reservoir state. Decontamination should not be necessary.
            - A biologic agent capable of infecting and surviving within wildlife tissue may create a biologic vector or reservoir state. These species may amplify the biologic contaminant for dispersal. Potential biologic vectors or reservoir species may require decontamination. However, this type of decontamination is the most difficult to accomplish and may require systemic anti-microbial therapy. Reservoir states or clinical infections will typically require some form of quarantine facilities.
            - Bio-contaminants that cause a high mortality pose less risk of dispersal than those with less clinical pathology. Acute or per-acute fatal disease immediately arrests transport of the agent to novel locations by the individual animals. However, carcass consumption by other wildlife may concentrate and transport the agent.
        3. Wildlife Suffering
            - Significant wildlife suffering due to the contaminant should be addressed. Decontamination or euthanasia may be ethically essential. Humane euthanasia may be required if wildlife suffering cannot be alleviated with or without decontamination. Difficult decisions may be required to determine whether decontamination is the most humane course of action. Significant risk to public health or agricultural species may require eradication of wildlife in a circumscribed hot zone. Euthanasia methods vary with species and available resources.
        4. Wildlife Morbidity and Mortality
            - Significant risk of wildlife morbidity or mortality may mandate intervention for wildlife's sake. However, decontamination of moribund wildlife may be an inefficient use of resources. The chance of long term survival must be considered. Surviving capture and decontamination does not always correlate with long term survival. Many contaminants cause irreversible terminal damage that may not be immediately obvious. If decontamination will prevent significant wildlife mortality, it should be considered.
- Prioritized Risk Prevention:
        1. Avoid Responder Contaminant Exposure
            - If decontaminating will place responders at significant risk of personal contamination, it may be impossible to perform wildlife decontamination safely. Exposure may occur not only from direct contact during the decontamination procedure, but from many potential other routes as well.

- Capture and restraint equipment, immobilization equipment and caging may also pose a risk of Personal Protection Equipment compromise. Pulling, displacing, removing, tearing or destruction of PPE by resistant wildlife can put responders at increased risk.

2. Avoid Responder Injury from Wildlife
   - Struggling wildlife may injure themselves or captors. Even herbivores can inflict painful or life threatening injuries. Appropriate restraint equipment that limits fighting makes decontamination safer. Without proper restraint equipment and knowledge, wildlife decontamination should not be attempted.
3. Avoid Responder Injury from Capture / Holding Equipment
   - Wildlife capture equipment can be dangerous to responders. Immobilization pharmaceuticals used in wildlife may be lethal to humans. Rifles, darts, capture poles, nets and caging must be handled appropriately to prevent traumatic responder injury.
4. Avoid Wildlife Self Trauma
   - The fight or flight response can be extreme in restrained or pursued wildlife. Immediate death can occur by capture myopathy (exertional rhabdomyositis) due to lactic acidosis and cardiac hypoxia. Non-lethal capture myopathy may also lead to myoglobinuria and renal failure weeks later. Direct trauma may occur from kicking or struggling to escape. Dark enclosures minimize stress and may decrease self-inflicted trauma. Even immobilization can lead to trauma inflicted during induction and recovery. Prey species are the most likely to traumatize themselves attempting to escape.
5. Limit Captivity Time
   - Healthy decontaminated wildlife should be released as soon as possible. Captivity itself is a health risk for both the keeper and the kept. Increased captivity length is associated with decreased long-term survival. Release locations must be determined prior to beginning any capture and decontamination attempt.
   - Captivity may be a greater risk to wildlife than the contaminant. Small birds may die in-hand. Some species typically expire within days from secondary infections, if caged. Most captive wildlife will inflict self-trauma in captivity, sometimes fatally. Captivity exposes responders to continued risk from wildlife contact.
   - Wildlife from snakes to loons to cetaceans require specialized husbandry. Requirements can be difficult to obtain in an emergency situation. Sending decontaminated wildlife to appropriate wildlife handlers allows emergency responders to focus on the mission.
   - The last choice is Emergency Responders responsible for long term captivity and care of wildlife. However, if it is inevitable, insure the enclosure, diet and safety protocols are complete before wildlife decontamination is attempted. Mandatory quarantine may necessitate longer-term captivity.
6. Release Healthy Wildlife, Free of Contaminants
   - It is the mission goal.

- Triage / Urgency:
  1. Animal Suffering Evaluation
     - Alleviation of animal suffering is always the first criteria for any triage. Relief of animal suffering should be the initial goal. The experience of decontamination itself is distressful to wildlife. A shaded, dark and quiet location may have therapeutic effect. Painful medical issues should be addressed first, prior to the decision to decontaminate.
- 2. Treatment vs. Humane Euthanasia
     - For animals with severe medical conditions due to contamination or other causes, euthanasia may be the most humane alternative, rather than subjecting them to decontamination.
  3. Degree of Public Health Risk
     - Extremely high public health risk may preclude the luxury of wildlife decontamination. Risk to responders associated with capture and decontamination may be too great to decontaminate wildlife. However, wildlife as vectors may necessitate intervention (decontamination or euthanasia) to insure public health. Wildlife species that are most likely to cause adverse public health sequelae may be targeted for depopulation or decontamination. Wildlife species that pose only limited risk to the public or agricultural species may be triaged to wait or ignored.

4. Degree of Domestic Species Risk
    - As with public health, species or individual animals may pose variable degrees of risk to domestic species. Urgency to decontaminate may be dependent upon the relative risk to domestic species. Agricultural species have a powerful economic impact. A threat to meat and production species will cause a significant response. Depopulation may be considered for agricultural threats posed by contaminated wildlife. A measured response is more appropriate with threats to domestic pets, non-production animals or common wildlife species.
5. Immediate Individual Health
    - Variable severity caused by the direct effects of the agent may mandate that some individuals be decontaminated immediately. Individual animals may have other life threatening conditions or concomitant disease that require evaluation or treatment prior to decontamination. Urgent care may be needed or euthanasia may be warranted rather than decontamination.
6. Long Term Wildlife Health Risk
    - Some contaminates show minimal immediate effects but long term survival may be lethal. Radiological and biological contaminates frequently have such effects. Rapid decontamination of clinically healthy wildlife may prevent long term effects. The risk of long term adverse effects is specific to each contaminant.
7. Individual Animal Degree of Contamination
    - Triage should consider individual animals' degree of contamination. More heavily contaminated wildlife should be considered for decontamination first.

- Other VMAT Resources and References:
    - Decontamination of wildlife safely requires that responders are familiar with the primary hazards posed by various species, proper wildlife handling techniques and chemical capture. Explanation of each of these requires an extensive address beyond the scope of this section. The following are available to VMAT personnel:
    - NDMS Online Training Programs
        - Wildlife Physical Restraint: Primary hazards and proper restraint techniques to avoid them in various species of wildlife.
        - Wildlife Chemical Restraint: Introduction to the equipment, techniques and pharmaceuticals for various species of wildlife.
        - Oiled Animal Response: Introduction to decontamination of wildlife contaminated with various petroleum products.
    - VMAT Field Guide
        - Wildlife in Disasters: Common Presentations, General Considerations and Wildlife Immobilization in Disasters.

APPENDIX 2. GENERAL CHEMICAL AGENT INFORMATION

- Specific classes of chemical agents
    - 1-Nerve agents such as GA (tabun), GB (sarin), GD (soman), GF, and VX
    - 2-Vesicants or blister agents such as mustard
    - 3-Cyanide and ricin.
    - 4-Lung–damaging (pulmonary) agents such as phosgene.
    - 5-Incapacitating agents such as BZ and riot-control agents (similar to MACE)
    - 6-Arsenical insecticides
    - 7-Methylmercury and inorganic mercurials
    - 8-Rodenticides
    - 9-Hydrocarbons/petroleum distillates.
    - 10-Solvents/detergents.
    - 11-Fumigants
    - 12-Paraquat herbicide
- 1-Nerve agents/organophosphate (OP) and carbamate insecticides
    - Nerve agents are highly toxic organophosphate compounds that irreversibly bind to cholinesterase, resulting in accumulation of acetylcholine at the nerve synapses and neuromuscular junctions. An

initial over stimulation of cholinergic receptors precipitates a cholinergic crisis, followed by paralysis.

- The time of onset and severity of central nervous system (CNS) symptoms and muscarinic and nicotinic effects are determined by dose, route of exposure, and properties of the specific agent involved.
- Highly toxic pesticides are likely to be used by terrorists or for malicious intent.
- Potential routes of exposure are inhalation, dermal, and oral.
- Examples of organophosphate insecticides:
  - Ethyl parathion, fonofos (parathion), mevinphos (dyfonate), monocrotophos (phosdrin), TEPP (azodrin), azinphosemthyl, disulfoton (guthion), methamidophos (disyston), mehtidathion (monitor), methyl parathion (supracide), phorate, sulfotepp (thimet), terbufos.
- Examples of carbamate insecticides:
  - Aldicarb (temik), carbofuran (furadan), and methomyl (lannate).
- <u>Signs and symptoms</u>
  - The onset of symptoms may be within a few minutes or up to 18 hours, depending on the degree of exposure. Common CNS effects are agitation, seizures, and coma. Inhalation exposure to sarin, the most volatile agent, may result in death in only a few minutes. A 2-mm^2 to 3-mm^2 area of dermal exposure to VX is potentially fatal.
  - Muscarinic effects tend to be the most prominent signs, e.g., salivation, lacrimation, urinary incontinence, diarrhea, gastrointestinal distress, and emesis; these are easily remembered using the mnemonic SLUDGE. Bradycardia, bronchospasm, and miosis may also occur.
  - Nicotinic effects resulting from acetylcholine stimulation of nicotinic receptors in sympathetic ganglia include tachycardia, hypertension, and pallor. Nicotinic stimulation at the neuromuscular junction causes muscle fasciculation, pain, and weakness particularly involving the respiratory muscles.
  - Death results most directly from respiratory failure caused by respiratory muscle paralysis, and loss of airway control.
- The impact of a nerve agent release would depend on the agent used, the method of release, and the environmental concentration. Those in closest proximity or downwind of a vapor release would be expected to have the highest mortality rates. Others in the surrounding area would display varying degrees of symptoms.

- 2-Vesicants or blister agents such as mustard
  - Potential routes of exposure are inhalation, dermal, and oral.
  - <u>Signs and symptoms:</u>
    - Generally, no immediate symptoms occur, and presentation may be delayed 2 to 24 hours after exposure. Once symptoms do occur, eye irritation, lacrimation, cough, and a burning sensation on the skin would likely be the first indication of exposure. Skin damage is characterized first by generalized painful inflammation, followed by blistering and desquamation.
    - Death is most likely to result from direct lung injury or sepsis. Coughing, and chest discomfort may be the first symptoms, followed by evidence of pulmonary edema and respiratory failure. Effects on tissues such as bone marrow and the immune system may be delayed for 5 to 10 days, and the increased risk of neoplasm resulting from DNA alkylation may not manifest for months or years.
- 3-Hydrogen cyanide and ricin
  - Reports of hydrogen cyanide use by Iraq in its war against Iran and against the Kurds prompts a discussion of this agent as a possible chemical terror weapon. Hydrogen cyanide is most dangerous if inhaled. Because it is highly volatile, high concentrations are difficult to achieve unless released into a confined space.
  - Cyanide compounds work by binding to and inhibiting cytochrome aa_3 in the electron transport chain, effectively stopping cellular respiration and resulting in tissue hypoxia and lactic acidosis.
  - After inhalation of high concentrations of hydrogen cyanide, death is practically instantaneous.

- Signs and symptoms:
  - Lower concentrations may produce tachypnea, restlessness, followed by seizures, coma, and death. The clinical syndrome essentially mimics hypoxemia and hypoxia; with the exception that cyanosis is absent.
- Ricin
  - A potent cytotoxin extracted from castor beans that inhibits protein synthesis.
  - Potential routes of exposure are oral, inhalation, and by injection
  - Cough, dyspnea, and fever characterize inhalation exposure.
  - Airway necrosis and lung injury develops over the next 2 to 3 days, manifested by hemoptysis and pulmonary edema.
  - Ingestion of ricin results in hemorrhagic gastroenteritis, shock, and death.

- 4-Pulmonary agents (phosgene, PFIB, HC and oxides of nitrogen).
  - Phosgene can be used alone or in mixed-substance shells, usually in combination with chlorine, chlorine gas is described as greenish-yellow with a strong pungent odor.
  - Phosgene gas forms a white cloud and is reported to have the odor of freshly mown hay.
  - Chlorine and phosgene are heavier than air, making them effective trench-warfare agents.
  - They exert their pathophysiologic effects by reacting with water, forming hydrochloric acid.
  - Mucous membrane exposure leads to severe irritation and pain.
  - Inhalation results in direct alveolar endothelial damage, possibly leading to non-cardiogenic pulmonary edema.
  - Perflurorisobutylene (PFIB), a product of Teflon combustion (Teflon lines many military vehicles).
  - HC smoke (a smoke containing zinc), and oxides of nitrogen (from burning munitions)
  - Signs and symptoms
    - Clinical effects of pulmonary agents exposure are dose-dependent.
    - Low levels can produce tearing, rhinorrhea, and salivation. Higher-level exposures will result in more severe respiratory effects: coughing, dyspnea, and wheezing.
    - Physical examination may reveal tachypnea, tachycardia, hypoxemia, and rales.
    - Non-pulmonary effects include muscle pain, weakness, and abdominal discomfort.
- 5-Riot control agents (mace/pepper spray)
  - Pepper spray contains capsaicin; a chemical derived from cayenne, paprika, or chilies. Capsaicin causes extreme irritation and pain when first exposed.
  - CS (o-chlorobenzylidene malononitrile) is one of several chemicals commonly called "Tear Gas." CS is a powder and is dispersed into the air as either an aerosol or powder.
  - Potential routes of exposure are inhalation, dermal, and oral.
  - Signs and symptoms:
    - These agents affect the eyes, airways and skin.
    - Ocular exposures cause burning, irritation, tearing and pain.
    - Airway symptoms include burning, sneezing, cough, shortness of breath and increased secretions such as runny nose and increased salivation. Gagging and vomiting may also occur.
    - Symptoms of dermal exposures include burning, redness and irritation. High concentrations of CS can cause blistering of the skin. Effects usually occur seconds after the exposure begins and usually end 30-60 minutes after exposure is terminated.
  - Severe effects would not be expected when animals are exposed outdoors for short periods of time.
- 6-Arsenical insecticides (especially trivalent arsenites)
  - Example of arsenical insecticides as sodium arsenite, copper acetoarsenite, arsenic trioxide and arsine gas.
  - Signs and symptoms:
    - Oral exposure can cause severe signs as severe abdominal pain, vomiting, diarrhea, salivation, neurological signs and death.
    - Arsine inhalation can cause signs as acute weakness, dyspnea, cyanosis, icterus, hemoglobinuria, hematuria and death.

- 7-Methylmercury compounds and inorganic mercurials
  - Examples are mercuric chloride, phenylmericuric acetate, methoxyethyl mercury, ethylmercury-p-toluene sulfonanilide, and methylmercury dicyandiamide.
  - Signs and symptoms:
    - Signs may develop within hours of exposure or may be delayed for several days.
    - The most common signs are paresis, ataxia, tremors, salivation, stomatitis, vocalization, hyperthermia, weakness, vomiting, and diarrhea.
- 8-Rodenticides
  - Examples that may be used by terrorists or for malicious purposes are strychnine and thallium sulfate.
  - Potential route of exposure is oral exposure.
  - Signs and symptoms
    - Common signs of strychnine toxicity are seizures (violent and tetanic), tremors, vomiting, disorientation, ataxia, weakness, rigidity, tachypnea, or dyspnea.
    - Common signs of thallium are gastrointestinal distress, brick red mucous membranes, and shock.
    - Neurologic signs usually are less pronounced in animals compared to humans.
- 9-Hydrocarbons/petroleum distillates
  - Sources: paints, varnishes, cleaning waxes, engine cleaners and degreasers, furniture polish, charcoal lighter fluid, lamp oils, household oils, greases, kerosene, turpentine, and gasoline.
  - Formulations
    - Aliphatic: straight chain
    - Cyclic: closed ring
    - Aromatic: hydrocarbons containing a benzene ring structure
    - Petroleum distillates: hydrocarbons refined from crude oil
    - Terpenes: hydrocarbons refined from pine oil
    - Phenols: coal pitch, coal tar
    - Petroleum distillates in order of increasing volatility:
    - Tar (least volatile)
    - Paraffin wax
    - Lubricating oil
    - Fuel oil
    - Mineral seal oil
    - Kerosene
    - Mineral spirits
    - Gasoline
    - Petroleum naptha
    - Petroleum ether (most volatile)
  - Aspiration of hydrocarbons causes the largest concern.
  - Dermal absorption is also possible, along with limited GI and subcutaneous absorption.
  - GI absorption of longer chain hydrocarbons (motor oil) is limited.
  - Signs and symptoms:
    - Most common signs in small animals
      - Respiratory: coughing, choking, wheezing, fever, dyspnea, and cyanosis
      - CNS: coma, CNS depression leading to ataxia, excitation, seizure, tachypnea, panting, and cardiac arrhythmias
      - Topical: mild to severe dermatitis, erythema, skin necrosis, and limb edema
      - GI: vomiting, diarrhea, and distinct odor to breath
      - Ocular: corneal irritation, pain, and redness
    - Most common signs in large animals
      - Respiratory: coughing, dyspnea, increased heart rate, reluctance to move, weakness, and oil-stained nasal discharge

        - CNS: anorexia, mild depression, excitability, shivering, head tremors, incoordination, mydriasis, and tonic-clonic convulsions
        - Topical: hyperemia, thickening or fissuring of skin, and skin or wool sloughing
        - GI: regurgitation of oil, dry stool (if ingested a more volatile oil), diarrhea (if ingested a less volatile oil), and bloat
        - Other: hepatopathy and renal tubular nephrosis
- 10-Solvents/Detergents
    - Examples: Alkaline batteries, calcium carbide, calcium hydroxide, calcium oxide, caustic potash, caustic soda, diethylene triamine, isopropylamine, isopropyl aminoethanol, lime, potassium carbonate, potassium hydroxide, potassium oxide, sodium carbonate, sodium hydroxide, sodium metasilicate, sodium oxide, sodium silicate, sodium tripolylphosphosphate, trisodium phosphate.
    - Potential sources: Drain openers, oven cleaners, bleaches, cleaners industrial pipelines, denture cleaners, bathroom and household cleaners, hair relaxers, and in electric dishwasher soaps and low phosphate detergents. Oven-cleaner pads may contain lye. Cement when mixed with water forms 60 to 65% calcium oxide (quick lime or unslaked lime.) Household bleaches (4 to 6% sodium hypochloride) are capable of producing superficial mucosal burns.
    - Potential routes of absorption are oral, dermal, ocular, and inhalation.
    - <u>Signs and symptoms:</u>
        - Most common signs: CNS depression, vomiting, oral lesions, food refusal, and drooling
        - Alkaline corrosive ingestions may produce burns to the oropharynx, upper airway, esophagus and occasionally stomach. The absence of visible oral burns does not reliably exclude the presence of esophageal burns. The presence of stridor, vomiting, and drooling are associated with serious esophageal injury in most cases.
        - Ocular exposure can produce severe conjunctival irritation and chemosis, corneal epithelial defects, permanent visual loss and in severe cases, perforation.
        - Dermal contact with alkaline corrosives may produce pain, redness, and irritation or full thickness burns.
- 11-Fumigants
    - Aluminum phosphide (phostoxin, fumitoxin), methyl bromide (meth-o-gas, brom-o-gas), sulfuryl fluoride (vikan).
    - The products are toxic by inhalation.
    - <u>Signs and symptoms</u>
        - Slow gait, vomiting, ataxia, seizure, and respiratory tract irritation or respiratory failure at high concentration.
- 12-Paraquat herbicide (gramoxone)
    - It is one of the bipyridayl herbicides
    - Potential routes of exposure are oral, dermal, ocular and inhalation.
    - <u>Signs and symptoms:</u>
        - Gi signs, acute respiratory distress syndrome, renal damage, hepatotoxic, and cardiac arrest.
        - Survivors generally develop progressive pulmonary fibrosis within 5-10 days.

APPENDIX 3. GENERAL DECONTAMINATION GUIDELINES FOR CHEMICAL AGENTS

- Prepare yourself mentally and physically. It will not be an easy task to work with animals while wearing PPE, especially during large animal decontamination missions.
- The key points to remember are that the safety of emergency responders is paramount over all other considerations.
- When setting up an emergency decontamination unit, time is critical and a sufficiently large area will be needed.
- The area of decontamination should be close to the scene but out of the immediate hot zone if possible. The area should be upwind, upgrade and/or upstream.
- Getting animals decontaminated is the number one priority, especially when dealing with chemical agents.
- Flushing or flooding contaminated skin with water or aqueous solutions can remove or dilute significant amounts of agent. When animal skin contaminated with GB was flushed with water (a

method in which physical removal predominates over hydrolysis of the agent), 10.6 times more GB was required to produce the same mortality rate as when no decontamination occurred.

- In another study, the use of water alone produced better results than high concentrations of hypochlorite (i.e., 5% or greater, which are not recommended for skin). Timely copious flushing with water physically removes the agent and will produce good results.
- It is necessary to control the water run-off and to know where it is going.
- Scraping with a wooden stick, i.e., a tongue depressor or popsicle stick can remove bulky agents by physical means.
- Each veterinarian will probably need at least two technicians or assistants to help him/her during the decontamination. Good communication is a must in this situation.
- Proper and suitable gear should be worn during the entire decontamination process.
- Liquids and solids are the only substances that can be effectively removed from the skin. It is generally not possible or necessary to decontaminate vapors; removal from the atmosphere containing the vapor is all that is required.
- An estimation of animal population in zones and sub-zones should be done quickly. To estimate the dog population for a specific zone or sub-zone, determine the number of households in the area and multiply this number by 38.2%x1.51.
- For cats, multiply this number by 30.5%x1.97.
- Documentation and identification each animal treated, held or euthanized is necessary.
- One or two areas will be needed to hold animals which do not require hospitalization, but require care their owners are unable to administer. These holding areas can also be used to temporarily house animals when the owner is not able to secure them or for other loose populations of animals which also need to be secured until they can relocated.
- For large animals, isolate the most severely affected and least effected animals and move them to the closest safe area available to start the decontamination.
- It is recommended to decontaminate large animals on-site if able since it will generally be very challenging and time consuming task to try to move large numbers of livestock.
- If you have different types of animal species, such as cattle, sheep and horses in the same area or premises, it is recommended to avoid mixing them all together in one group and it will be even more practical if they can be separated according to age. (Very young and elderly animals may need more attention during the process of decontamination).
- Use appropriate identification methods for individual animals or herds.

APPENDIX 4. GENERAL DECONTAMINATION GUIDELINES FOR BIOLOGICAL AGENTS

- Characteristics of Biologic Agents in General
    - Do not penetrate unbroken skin
    - Non-volatile
    - More toxic than chemicals by weight
    - Undetectable via senses
    - Limited field detection
    - Disseminate as aerosols
    - Wide range of effects
    - Obtained from nature
    - Relatively easy to produce
    - Have delayed effects
- Specific Categories
    - Viral
    - Bacterial
    - Rickettsial
    - Parasitic
    - Toxin
- Potential Routes of Contamination
    - Oral
    - Dermal

    - Inhalation
    - Injection
- Methods of Delivery
    - Contamination of food or water sources
    - Aerosolization of spores or liquid
    - Breaking devices
    - Exploding/Bursting devices
    - Spraying devices
    - Contamination of fomites (vectors)
- General Decontamination Considerations
    - How to move them through the DECON unit?
    - How to deal with injured patients?
    - What if the patient is fractious?
    - Are tables needed to elevate some patients?
    - Varying sizes?
    - Varying weights?
    - Various haircoats?
- Possible Scenarios
    - A crop dusting plane is used to deliver *Brucella melitensis* over a beef farming community. The cattle, humans and companion animals are infected via inhalation.
    - Release of mosquitoes infected with the Rift Valley Fever virus at multiple sites near large cattle farms across US during summer months. The cattle are exposed via the mosquitoes. Humans and other domestic animals also exposed via mosquito bites. The mosquitoes lay eggs that may be dormant for many years. Other biting insects become infected from feeding from infected cattle.
    - Contamination of a water supply.

APPENDIX 5. GENERAL DECONTAMINATION GUIDELINES FOR RADIOACTIVE AGENTS

- Radiation consists of charged particles or electromagnetic waves produced by the decay of atoms or through the breakdown (fission) of atoms. Damage to living tissue occurs when these particles or waves transfer their energy to molecules within cells and disrupt the cell's normal function.
- Types of radiation
    - Particles
        - Alpha (α) particle
            - "Large" positively charge particle consisting of 2 protons and 2 neutrons ("naked" helium atom) Common alpha emitters include radium, uranium, and plutonium.
            - Poor external penetration; cannot penetrate through the dead cells of the epidermis.
            - Greatest hazard is from ingestion or inhalation of the radioactive compound. Deposition of the compound in the lung or bones, for instance, allows production of alpha particles close to tissue that can be damaged.
        - Beta (β) particle
            - Negatively charge particles, they are high-speed electrons emitted from the decay of nuclear protons to neutrons
            - Common beta emitters include carbon-14, tritium, and strontium-90
            - Can have a wide range of energies and speed
            - Can penetrate the body from external sources and do cellular damage
        - Positron
            - Positively charged particle; the antimatter version of the electron.
            - Rare; produced by decay of a few isotopes such as sodium-22 and fluorine-18.
            - Interaction of a positron and electron leads to annihilation of both particles with the release of gamma radiation.
        - Neutrons
            - Neutrally charged particles
            - Not produced by decay of natural elements

        - Produced as a product of nuclear fission (reactors, nuclear explosions)
        - Interact with other atoms and produce protons and gamma rays
    - Protons
        - Positively charged particle
        - Not produced by spontaneous radioactive decay
        - Liberated from atom by other particle or gamma ray
    - Waves
        - Gamma rays
            - High-energy electromagnetic wave
            - Common gamma emitters are Iodine-125, iodine-131, and cobalt-60; beta particles are often produced at the same time
            - Do not directly damage tissue; they liberated electrons from atoms which then do damage similar to a beta particle
        - X-rays
            - High-energy electromagnetic wave similar to a gamma ray
            - Produced by electron interaction with matter
- Radiation Safety
    - Principles of protection
        - As distance increases, exposure decreases
        - Decreased time decreases exposure
        - Increased shielding thickness attenuates particles and rays and decreased exposure
- Dosimetry
    - Monitor exposure
        - Film badges monitor over time
        - Results not known until after the exposure has occurred
    - Real-time monitoring (radiation-detection instruments)
        - Measure real time radioactive emissions
        - Various types that can measure presence of alpha-, beta-particles and/or gamma/x-rays
        - Geiger Radiation Detector Counter is probably the best known
- Radiation Medicine
    - Short-term effects
        - Damages rapidly dividing cells; effects depend on dose
        - Gastrointestinal signs: vomiting, diarrhea, fluid loss, hemorrhage
        - Hematological signs: lymphopenia, neutropenia, thrombocytopenia; signs may take weeks to develop
        - Neurological signs at high doses can cause confusion, disorientation, stupor, coma, and death
    - Long-term effects
        - Genetic damage leading to mutation, cancer, and/or teratogenisis
- Potential routes of contamination
    - Inhalation
        - Dust or gas can be inhaled
        - Deposition of radioactive particulates in lung can lead to long term irradiation of lung tissue and cancer
    - Ingestion
        - Swallowed dust or contaminated water/food
        - Absorption into body depends on compound
            - Plutonium, for instance, is poorly absorbed via oral route and low toxicity; inhaled plutonium, however, is very toxic due to prolonged irradiation of lung tissue and cancer promotion.
            - Some absorbed compounds can be incorporated into tissue and pose long term threat
                - Iodine incorporated in thyroid
                - Strontium-90 incorporated into bone
    - Dermal
        - Deposition of particles on the skin.

        - Most dangerous with beta- and gamma-radiation emitting isotopes since alpha particles can't penetrate the epidermis.
    - External
        - Exposure can occur via release of energetic particles and waves at a distance such as in the early phase of nuclear explosion or highly-contaminated area
- Decontamination
    - Special issues
        - Radioactive materials cannot be inactivated by sterilization, anti-viral/anti-bacterial agents, or burning
        - Material stays active for days to years depending on half-life
        - Heavily contaminated carcasses can continue to be a hazard
        - Storage until safe in shielded facilities
    - Decontamination
        - Dermal decontamination is accomplished with mild soap and water and light scrubbing
        - Monitor progress using real-time radiation detectors (e.g. Geiger counter)
        - Heavy scrubbing may drive material deeper into the tissues or lead to inflammation that will allow absorption of radioactive compounds
        - Wounds should be copiously irrigated
        - Appropriate decontamination garb for external radiation hazard
            - Filter masks can protect against inhalation of particles but not useful against gaseous compounds.
            - Depending on compounds involved, standard anticontamination suits may be adequate.
            - Personnel should be limit exposure time and be decontaminated after exposure.
        - Water may remain contaminated and needs to be handled appropriately
        - Internal decontamination
            - Supplementation with large doses of oral iodine to saturate the thyroid and prevent incorporation of radioactive iodine in the thyroid gland. Most effective within the first hour. After 24 hours, not effective. Recommended dose of potassium iodide (KI) varies from 16.25-65 mg a day for children depending on age to 130 mg a day for adults; dosing continues until exposure is not longer significant. (from *Guidance: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies*, US Dept of HHS, FDA, and CDER, December 2001). There is no dosing recommendation for nonhuman animals.
            - Calcium supplementation may be prevent strontium deposition in the bones
        - Large vs. Small Animal considerations
            - Procedures would be the same
            - Only difference may be with internal contamination with small animals, especially cats, who may groom and ingest dermally deposited compounds
        - Animal waste
            - Self grooming could lead to ingestion of radioactive material
            - Urine/feces should be monitored with radiation detectors to for possible contamination
            - Waste material must be handled appropriately to prevent environmental contamination with radioactive material
- Possible scenarios
    - Nuclear explosion
        - Result of explosion of fissionable material – uranium or plutonium
        - Initial injuries due to blast and thermal injury
        - Production of large quantity of high-speed neutrons and gamma rays. These have direct effect on tissue; they may also create radioactive elements (mainly through neutron capture) in the soil close to the explosion
        - Fallout
            - Initial explosion converts very little uranium/plutonium to energy so explosion releases large quantities of uranium and plutonium

        - Fission reaction creates over 300many new radioactive isotopes including iodine-131 (which can be taken up by thyroid), cesium-137, and strontium-90 (which is incorporated in bone)
        - Deposition depends on prevailing winds
        - Fallout may be inhaled, ingested, or deposited on surfaces for dermal exposure
- Nuclear Power Plant Accident
    - Nuclear power plants used controlled fission reaction to produce heat and power
    - Uranium or plutonium fuels
    - Many of the same isotopes are produced during the reaction
    - Radioactive gases and particles may be released during a meltdown and breach of containment.
    - Area of contamination would depend on size of the release and prevailing wind
- Dirty Bomb
    - Conventional explosive with incorporated radioactive material
    - Not a nuclear explosion
    - Explosion disperses radioactive material with inhalation and dermal contamination
    - Any radioactive material could potentially be used
- Contamination of food/water
    - Introduction of radioactive products into water or food
    - Effects depend on material
    - Some radioactive material is very low toxicity via oral route (e.g. plutonium)

Other agents such as radioactive iodine (thyroid) or strontium (bone) can be incorporated in tissue and pose a long-term cancer risk.