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**National Animal Health Emergency Management System Guidelines**

**U.S. Department of Agriculture**

**2003**

**Operational Guidelines**

# Cleaning and Disinfection

The National Animal Health Emergency Management System Guidelines provide an operational framework for use in dealing with an animal health emergency in the United States.

The guidelines are produced by the
Veterinary Services Unit of the Animal and Plant Health Inspection Service,
U.S. Department of Agriculture.

These guidelines are under ongoing review. Please send questions or comments to:

Emergency Programs
Veterinary Services
Animal and Plant Health Inspection Service
U.S. Department of Agriculture
4700 River Road, Unit 41
Riverdale, Maryland 20737-1231
Telephone: (301) 734-8073 or 1-(800) 601-9327
Fax: (301) 734-7817
E-mail: EMOC@aphis.usda.gov or NAHEMS.Guidelines.Comments.aphis.usda.gov

The above address also may be used to request paper copies of the guidelines.

## PREFACE

"Cleaning and Disinfection," a component of APHIS' National Animal Health Emergency Management System (NAHEMS) Guidelines series, is designed for use by Veterinary Services (VS) personnel in the event of a major animal health emergency such as an incursion of a foreign animal disease or a natural disaster in the United States. The NAHEMS guidelines provide information that may be integrated into the preparedness plans of other Federal agencies, State and local agencies, and additional groups involved in animal health emergency management activities. Topics covered in the guidelines include:

- Field investigations of animal health emergencies
- Disease control and eradication strategies and policies
- Operational procedures for disease control and eradication
- Site-specific emergency management strategies for various types of facilities
- Administrative and resource management
- Educational resources

The NAHEMS guidelines provide a foundation for coordinated national, regional, State, and local activities in an emergency situation. As such, they are meant to complement non-Federal preparedness activities. The guidelines are being reviewed and updated on an ongoing basis, and comments and suggestions are welcome.

"Cleaning and Disinfection" provides guidelines for Cleaning and Disinfecting Unit Leaders and associated personnel responsible for cleaning and disinfecting activities. The guidelines are meant for use as a practical guide rather than as a comprehensive reference resource.

The general principles provided in the guidelines are intended to serve as a basis for making sound decisions. However, deviations from the guidelines may be permissible, if necessary, to address a given situation effectively. In addition, information provided in various sections may need to be combined to meet the requirements of a particular situation.

**ACKNOWLEDGMENTS**

"Cleaning and Disinfection" reflects the efforts of a number of individuals, including an APHIS Veterinary Services (VS) Writing Group, additional APHIS staff members, and a wide range of reviewers. The reviewers include Federal and State Veterinarians, members of APHIS' animal health emergency response teams, officials of other Federal agencies, representatives of industry, and additional experts. The contributions of each individual are appreciated.

Also acknowledged with appreciation are the efforts of USDA staff and external reviewers involved with the development of the VS animal health publications ("red books") and similar documents that have served as information sources for the NAHEMS guidelines.

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## Chapter 1 Introduction

Cleaning and disinfection are tools used to impede the spread of pathogenic microorganisms. They become critical tools with the incursion of any of the highly contagious diseases (HCDs). In situations where a contagious disease is involved, vehicles, holding pens, equipment, various facilities and with HCDs, entire premises need to be cleaned and disinfected. The appropriate use of cleaning agents and disinfectants is especially critical with the current terrorist threat and the possibility of the use of biological agents. The individual entrusted with cleaning and disinfecting activities should cultivate a broad knowledge of the general nature of cleaners, disinfectants and where suitable, generic chemicals that can be readily obtained for cleaning and disinfection, rather than just information about specific commercial brands.

When approaching the issues of cleaning and disinfecting (C&D), it must be clear that disinfecting is not sterilization. Disinfecting reduces the number of pathogenic microorganisms below a harmful level while sterilizing eliminates all microorganisms (and spores). It is impractical to consider sterilizing a corral, barn, paddock, or truck – and it would be unprofessional for medical professionals to merely disinfect surgical instruments.

One of the primary means of spread of HCDs is through movement of infected animals, animal products, or fomites (e.g., feces, bedding, vehicles, and harness) conveying disease-producing agents to locations where they come into contact with susceptible animals. Adequate cleaning and disinfecting can prevent the movements of microorganisms on fomites.

This document will briefly describe the materials used for cleaning and disinfecting as well as the techniques for the C&D of various items of equipment and facilities. Cleaning and disinfecting is critically important to prevent the spread of disease through movement of fomites which have been in contact with live animals, animal products, or areas where they have lived or been stored. Correctly applied, C&D will prevent the movement of microorganisms on fomites and prevent the contamination of fomites or infection of animals that come in contact with areas where infected animals were housed. These measures, if properly implemented, will reduce the risk of pathogen transmission during the period while highly contagious disease pathogens are being eliminated from the national herd.

### Cleaning

Blood and Studdert specify that cleaning is a major part of sanitation procedures in veterinary preventive medicine because of the heavy contamination of animal accommodation by feces and urine, and in abattoirs because of the rapid accumulations of fat. Blood and Studdert also note that, “High pressure cleaning with hot water and detergents is the only practicable procedure but brings its own attendant problems of the disposal of effluent.”

**Disinfectant**

A disinfectant is a physical agent or chemical agent that destroys vegetative forms of harmful micro-organisms, usually on inanimate objects but sometimes on the coat or hooves of animals. It is important to note that not all agents work against all microorganisms and that most disinfectants are likely to be less effective against spores.

The guidelines are for those situations where it is necessary to control and eliminate HCDs and for dealing with diseases that are not highly contagious. The concepts provided can reasonably be applied to other disease control situations within the agricultural community. The guidelines are meant for use as a practical field resource rather than as a comprehensive reference work. Additional information which references the spread of pathogens and the use of disinfectants may be obtained from references listed in Chapter 10.

The NAHEMS guidelines focus on essential areas such as the responsibilities of C&D Unit personnel, a general outline of the agents and materials that can be used to disinfect, the selection and use of disinfectants and cleaning agents. The document is designed for use not only in emergency situations but also in animal health emergency training programs.

**Emergency Response Exercises**

Test exercises should be a regular feature of preparation for animal health emergencies; C&D Unit personnel should use the "Cleaning and Disinfecting" guidelines to help them expand their knowledge of animal health emergency management. Such sessions will help learners identify likely emergency scenarios and develop the techniques for designing detailed plans for responding to each scenario effectively.

**The First 24 Hours—**In a test exercise preparing for a disease outbreak, responses during the initial 24 hours should be considered critical. Create a detailed plan for the application of "Cleaning and Disinfecting" guidelines during the first 24 hours of an animal health emergency with a confirmed disease.

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 will ensue?
- How much cleaning material and disinfectant should be ordered to cover the first 7-days and 30-days of operation?
- What equipment and personnel will be needed for premises to be disinfected?
- How much time should be allowed to disinfect premises?
- At what locations should cleaning and disinfection stations be established?

- What vehicles will need to undergo C&D?
- What vehicles can be excluded from C&D?
- What obstacles to operations may appear, and how will they be overcome?
- What conflicting pressures are likely, and how will they be balanced?
- What relationships with other key personnel, including individuals in the emergency management community, should be in place prior to the emergency?
- 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?
- If an initial plan fails, what are the elements of an effective alternative plan?

**Evaluation—**The evaluation phase of test exercises will provide participants with the opportunity to use the guidelines to (a) evaluate the strengths and weaknesses of their responses in the simulation exercises and (b) focus on ways to 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.

**Interagency Outreach**

If the presence of a foreign animal disease, arthropod vector, or other type of animal health emergency is identified in the United States, the appropriate local, State, and Federal Governments 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) help 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, State, Federal, and industry officials, with response coordination provided primarily at the State and regional levels and with national-level consultation and consequence management (e.g., trade issues).
- *A regional response.* A regional response is managed by State, Federal, and industry agricultural 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.
- *A national response.* This level of response requires the combined efforts of local, State, industry, and national agricultural authorities and other 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. A State-based, nationally coordinated Animal Emergency Response Organization (AERO) model addresses this need.

The AERO model is based on the Incident Command System (ICS), an emergency response approach used widely in the emergency management community. To promote the widest possible application and implementation of guidelines content, this publication refers to the titles of officials and groups based on the AERO/ICS model. It is hoped that this approach will help the reader understand essential aspects of animal emergency response activities in terms of this model.

## Chapter 2 Functions of the Cleaning and Disinfecting Unit

Cleaning and disinfection personnel provide services that are essential to an effective animal health emergency response.

The C&D Unit, which is located with the AERO Operations Section, works closely with other units to ensure smoothly functioning operations (see Figure 1). Ideally, C&D Unit personnel will arrive on the premises during euthanasia and disposal and provide C&D for all vehicles, equipment, and personnel leaving the premises.

**(NOTE: This diagram is in the process of being revised. In the final version, the terms "Biosecurity" and "Quarantine and Movement Control" will be added under the Operations Section.)**

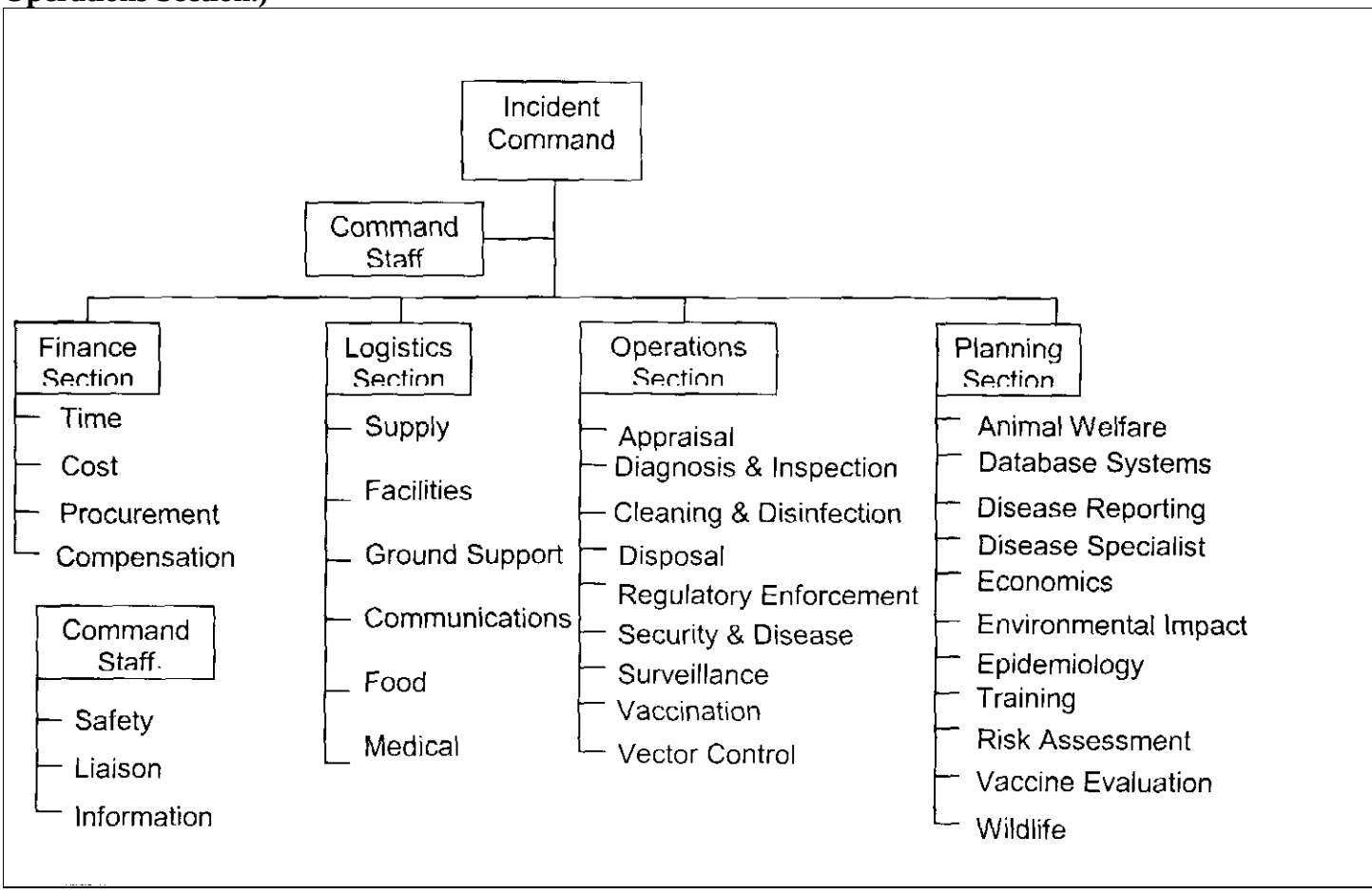


Figure 1. Typical Animal Emergency Response Organization.

The functions of the C&D Unit include:

- Providing input to the Command level on technical questions relating to C&D

- Providing technical advice on C&D issues to owners or operators of infected or contact premises

- Operating or arranging for C&D stations for AERO vehicles

- Coordinating closely with the Logistics Section to ensure an ample supply of disinfectant

- Coordinating closely with the Biosecurity Unit to insure that necessary equipment and supplies are available for use on quarantined premises

- Providing personnel to supervise C&D of quarantined premises

- Providing equipment, assistance, and supplies to quarantine Checkpoints or movement control checkpoints as requested

Through the use of suitable equipment, chemicals, and application techniques, the C&D Unit helps to prevent the movement of infectious agents from one location to another on fomites and to eradicate disease agents on infected premises.

Key C&D Unit personnel include (a) the C&D Unit Leader, who is based at the Incident Command Post, (b) C&D Team Managers who are responsible for activities on specific premises, C&D stations or checkpoints, (c) multiple C&D Team Members who, in teams or alone, perform the activities listed above

All C&D Unit personnel should read and understand the procedures discussed in these guidelines and in other appropriate information sources such as those contained in Appendix I. They also should participate in educational sessions and emergency response exercises designed to help them expand their knowledge of and expertise in animal health emergency management using the ICS.

**Cleaning and Disinfecting Unit Leader**

The C&D Unit Leader has the primary responsibility for ensuring that C&D measures are implemented effectively during an animal disease outbreak or other animal emergency (e.g., natural disaster). The goal of C&D is to prevent a disease agent from moving from infected premises to uninfected premises and to reduce the number of pathogenic microorganisms on infected premises below a harmful level.

The C&D Unit Leader must ensure that all C&D unit personnel are familiar with direct, indirect, and arthropod-borne mechanisms of pathogen transmission. They must understand that pathogen transmission to susceptible species (including humans in the case of zoonoses) may occur:

- Directly, via animal contact with an infected animal or infected animal products, including blood; secretions (e.g., milk and saliva); excretions (e.g., manure and urine); epidermal outgrowths (feathers, hair, wool, horns, and hooves); and exhaled moisture.

- Indirectly, via animal contact with contaminated feed, and water; fomites (e.g., clothing, tools, equipment, vehicles, bedding, supplies, and other inanimate objects); and people or animals (e.g., roaming and scavenging wildlife—including vermin and dogs—on the premises and surrounding areas) who are contaminated with a pathogen, but not infected or susceptible to it.

- Via arthropod vectors (e.g., insects and ticks) that may serve either as mechanical carriers of a disease agent or as an important part of the life cycle of the agent (e.g., mosquitoes that carry the Rift Valley fever agent).

C&D Unit personnel must understand the ways in which their application of proper C&D techniques can be used to manage or eliminate the first two of these means of pathogen transmission.

**General Responsibilities**

The C&D Unit Leader should be identified well before disease outbreaks or other animal health emergencies occur. This individual:

- Ensures that up-to-date contact information is maintained on personnel who are willing and qualified to serve as C&D team members. Complete contact information for all C&D team members should include names; home, business and express mail addresses; e-mail addresses; cell, office, pager and home telephone numbers; and fax numbers.

- Maintains a working knowledge of State and Federal regulations pertaining to the application of C&D agents and proper effluent management.

- Assigns personnel to C&D teams, arranging and organizing teams as necessary to achieve the goals of the Incident Commander.

- Supervises all personnel assigned to the C&D Unit within the ICS.

- Coordinates with owners/managers regarding all phases of C&D.

- Establishes and maintains C&D stations as needed.

- Verifies the accuracy and completeness of all required reports and submits them promptly to the APHIS Emergency Management Response System (EMRS) or to a similar acceptable reporting system.

- Informs industry groups and the interested public of the location of C&D stations and the need to use them. Affected industry groups may include renderers, feed-mill operators, transportation company representatives, livestock and poultry producers, processing-plant managers, and others.

- Determines the number and types of personnel, vehicles, and equipment needed to conduct C&D operations. Communicates unit needs to the Operations Section Chief to ensure that the required resources are available.

- Identifies personnel training requirements and is responsible for orienting new employees to the specifics of their duties within the C&D Unit.

- Ensures that the Safety Officer orients all new personnel regarding on-the-job hazards and ways to avoid them and their responsibilities in regard to biosecurity procedures

- Coordinates C&D Unit activities with the activities of personnel from other units (e.g., Surveillance, Appraisal, and Biosecurity)

- Prepares regular briefings and reports for the Operations Section Chief and notifies him or her immediately of any problems.

- Cooperates with appropriate animal health emergency groups.

**Cleaning and Disinfecting Team Manager**

The C&D Team Manager is typically given responsibility for one of the C&D functions which have been activated for a specific incident. In a large incident, different C&D Team Managers will manage the functions of vehicle disinfection stations, quarantine premises equipment and supplies (which will include onsite coordination with the Biosecurity Unit), checkpoint equipment and supplies, and premises C&D supervision. The C&D Team Manager:

- Orients C&D Team Members to their duties, providing them with training in C&D policies and procedures.

- Assigns tasks (e.g., operation of C&D at a checkpoint or supervision of C&D on premises) to C&D Team Members and supervises their work.

- Assists the C&D Unit Leader in determining the personnel, vehicles, and equipment required to operate the C&D activities efficiently.

- Liaises with the premises owner or manager on all technical questions related to C&D.

- Arranges for required C&D for all vehicles, equipment, and other materials leaving an infected, contact or suspect premises (premises that are related to infected premises by sound epidemiological evidence).

- Provides C&D support to the Biosecurity Unit including liaison with the assigned Biosecurity Team Member who is the permanent guard on infected premises.

- Maintains knowledge of disease prevention principles and practices.

- Prepares regular briefings and reports for the C&D Unit Leader and notifies him or her immediately of any problems or issues.

**Cleaning and Disinfecting Team Member**

Personnel serving in the C&D Unit may be drawn from a number of sources. APHIS and State cooperators have Animal Health Technicians with the training and experience to supervise C&D and, if necessary, to handle and apply C&D agents. Local pest control companies have experience in working with the spray equipment and pressure pumps commonly used in C&D. In the agricultural community, there are businesses which specialize in C&D of facilities. Members of the military from the Department of Defense are available through memorandums of understanding between departments. Local hires can be trained for specific application activities.

**Hazard Communication**

All members of the C&D Unit should have a complete orientation covering the various hazards which may be encountered while serving during an incident. Personnel within the C&D Unit will be entering infected quarantine premises on a regular basis. Before any C&D work is initiated, the C&D members should be briefed fully by Training Unit personnel (see the AERO "Roles and Responsibilities" Guidelines, in progress) as to the nature of the disease with which they are dealing. When the need to enter quarantined premises arises, C&D personnel should consult with the Biosecurity Team Member in charge of the premises so that each understands exactly what the other is doing.

A complete understanding of the specific safety precautions or hygiene requirements should be obtained before the C&D team enters the premises. (This is particularly important if a zoonotic disease is involved.) See the information regarding Safety in Chapter 6. Respirators should be available if the personnel are at risk from a disease organism or chemical hazard, if significant amounts of dust are generated, or upon individual request. (For further information on respirators, see the APHIS Respirator Program Guidelines in APHIS' "Safety and Health Manual," Chapter 11, Section 3.)

**Personnel Orientation Factsheets**

Certain sections of this document may be especially relevant to the responsibilities of individual C&D Team Members. The C&D Unit Leader may wish to distribute one-page or two-page laminated factsheets on various responsibilities or tasks to these individuals. For a sample factsheet, see "Biosecurity Dos and Don'ts" (Appendix I).

**Assessing Needs**

The C & D Unit Leader, in consultation with C&D Team Managers will determine equipment and vehicle needs at the time of the animal health emergency. The C&D Unit Leader should work with State emergency management agencies to identify C&D Team Members with required expertise from multiple government and private sources.

The C&D Unit Leader 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 C&D Unit Leader also will also work with appropriate officials to issue contracts and leases regarding equipment or personnel for the C&D operations.

## Chapter 3 Disinfectant Agents

### Regulation

Disinfectants are regulated by the Environmental Protection Agency (EPA) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); Title 40 of the Code of Federal Regulations (CFR). Individual States also have regulations which may be stricter than the federal regulation. The information that follows provides the reader with a general knowledge of the chemicals and physical agents which can be used as disinfectants and is intended to give the reader the background to make informed decisions in selecting EPA approved disinfectants. Any product that is used as a disinfectant must have an EPA product registration number and must be used according to label directions OR approved for use under FIFRA Section 18; that section authorizes EPA to allow States to use a pesticide for an unregistered use for a limited time if EPA determines that emergency conditions exist.

Appendix V lists those disinfectants approved under FIFRA Section 18 for use by APHIS against Office International des Epizooties (OIE) List-A Foreign Animal Diseases. In the case of a disinfectant that is not listed or when the disease is not listed on the label of an EPA approved disinfectant, it is possible to get a Crisis Exemption which is valid for a period of 15 days while the Section 18 exemption is being prepared and processed. A full explanation of FIFRA Section 18 and the Crises Exemption process can be found at www.epa.gov/opprd001/section18/.

In two special cases, chemicals have been approved under FIFRA Section 18 for use by State officials and the general public against Foot-and-Mouth Disease (FMD). Those two special cases are: Sodium hypochlorite in concentrations up to 12.5% and acetic acid at a concentration of 4% – 5%. If VS recognizes that there is a need, Section 18 exemptions may be applied for and publicized in the future to combat foreign animal disease (FAD) incursions.

### Physical Disinfecting Agents

**Heat—**Increase in temperature causes an increase in chemical activity which results in most disinfectants working better at higher temperatures.

***Moist Heat***—When heat is used for disinfection purposes it can be applied most effectively by using hot water or steam. Through the coagulation of protein, all vegetative microorganisms can be killed by 176° F (80°C) for 10 minutes. Anthrax spores will be killed by 212° F (100°C) for 10 minutes but *Clostridium botulinum* and *C. subtilis* spores withstand boiling for hours.

***Pasteurization*—**In the industrial setting, pasteurization is one specialized application of moist heat. It is important to note that pasteurization does not kill all of the microorganisms in milk or other liquids. It is intended to reduce the bacterial contamination and, in the case of milk, to kill *Mycobacterium bovis*, *Brucella abortus*, and *Salmonella sp*. without altering the flavor or nutritional quality of the milk any more than necessary.

***Autoclaving***—The autoclave is one of the most effective methods to destroy microorganisms. Pressure is key to this device, since water boils at higher temperatures when the pressure is raised. Water boils at 212° F (100°C) at sea level, while at 15lb/in$^2$ (~1 Atmosphere of pressure) it boils at 250° F (121°C). The higher temperature and moist heat significantly reduces the time necessary to penetrate any porous materials in the autoclave and kill microorganisms.

***Dry Heat***—The use of flame or baking is less effective than moist heat for disinfection. Vegetative microorganisms are more resistant to dry heat than they are to moist heat and spores are even more resistant. Some examples of the application of dry heat would include the incineration of carcasses or other biomedical waste, the heating of a bacterial loop in a Bunsen burner flame, the searing of a surface before sample collection, and the cauterizing of a wound.

**Radiation**—Energy levels determine whether radiation is classified as non-ionizing or ionizing. The nature of field work precludes the use of many forms of radiation, especially ionizing or high energy radiation. Among non-ionizing or low energy radiation, ultraviolet light (one part of sunlight) provides the most practicable radiation energy option for field disinfection.

***Ultraviolet Light***—Produced by sunlight or mercury vapor lamps, ultraviolet light will damage cellular DNA. UV light produces primarily a surface effect and does not penetrate even a thin layer of protein or pigment. It can be used as a supplemental disinfection method in clean areas (e.g., surgical suites or media preparation areas) to reduce bacterial burden in the air. UV light can be used to disinfect water if very thin water layers are exposed to the light. Humans and live animals should not be exposed to high levels of UV light because of skin and eye damage.

**Filtration**—filters and ultra-filters can be used to remove microorganisms from gases and fluids. Filtration is used for producing clean water in water treatment plants and is nature's way of cleaning water as it percolates through soil and rock into ground water. Filtering is used to produce microorganism-free solutions when other methods would be detrimental to the product, for example in the production of fetal calf serum. High efficiency particulate air (HEPA) filters are used to filter the air for surgical suites, laboratories, industrial processes, and to assure the safety of air discharged from biologic safety cabinets.

**Impact—**For general use, explosives cannot be recommended as disinfectants and are not practicable for field use at this time.

**Chemical Disinfectants**

**Soaps / Detergents—**Soaps and detergents are disinfecting agents. These agents serve inactivate the cell walls of bacteria and destroy the envelope of enveloped viruses. Soaps and detergents also peptonize proteins which help to remove bio-films composed of animal exudates, secretions and excretions (e.g., serum, pus, urine, manure, milk). When dealing with contagious diseases, soaps and detergents are generally used for cleaning and other products are then used as a final disinfectant. Proper cleaning will remove up to 99% or more of infectious material and render the surface visibly clean. A visibly clean surface is absolutely necessary before disinfection will be effective. For this reason, *cleaning is the most important step in C&D.*

**Phenol and Coal Tar Acids**—historically phenols were produced by the destructive distillation of coal. During fractional distillation, phenol boils off at 360° F(182°C), cresols boil off at 376-396° F (191-202°C), xylenols boil off at 410-446° F (210-230°C), and finally the higher temperature tar acids boil off at 446-590° F (230-310°C). Modern manufacture of 90% or more of the phenolics is by synthetic process.

***Commercial Phenols***—the phenols [$C_6H_5OH$] are protoplasmic poisons which can be readily absorbed through the skin. In concentrated solution, they cause severe burns and are fatal if swallowed. They are very effective against bacteria, reasonably effective against enveloped viruses but are not effective against non-enveloped viruses. One of the substituted phenols, 2-phenylphenol is particularly effective against mycobacterium species which are normally quite refractory to disinfectants. It was extensively used during the campaign against *Mycobacterium bovis* in the United States. This has given 2-phenylphenol an unjustified reputation of being the broad spectrum disinfectant of choice. It should be particularly noted that bacterial spores are very resistant to phenols at ambient temperature. Temperature is an important limitation to the use of phenols. In recognition of this, 9 CFR §71.12 (b) states, "It is absolutely necessary that the solution be applied at a temperature of 60°F or over. Whenever the temperature of the building to be disinfected is below 60°F (15.6° C), as indicated by a wall thermometer, the solution shall be heated to 120°F (49° C) and higher in very cold weather, to insure effective disinfection." Phenols have limited effectiveness in the presence of organic matter and should be used only on pre-cleaned, nonporous surfaces.

***Carbolic Acid***—A solution of phenol in water called carbolic acid is mentioned in Title 9 CFR §71.10 (a) (2) as a permitted disinfectant. Title 9 CFR §71.10 (a) (2) recommends using the liquefied phenol (U.S.P strength 87% phenol) in the proportion of at least 6 fluid ounces to 1 gallon of water.

***Cresylic Acid***—the combined fraction of cresols and xylenols, called cresylic acid, is also mentioned in 9 CFR§71.10 (a) (1) as a permitted disinfectant. Title 9 CFR §71.10 (a) (1) recommends using "Cresylic disinfectant" in the proportion of at least 4 fluid ounces to 1 gallon of water. As disinfectants, cresylic acid and the high temperature tar acids are more effective than phenol.

**Acids—**the hydrogen ion (H+) is bacteriostatic in the pH range of 3-6 and bactericidal when the pH drops below 3. Acids are effective against bacteria and enveloped viruses. They are not effective against non-enveloped viruses, with the exception of FMD virus, which is particularly sensitive to acids. Acids are not effective against the mycobacterium species, and only certain acids are effective against spores.

***Mineral Acids***—The mineral acids can be used for disinfectants but they are terribly corrosive. Hydrochloric acid [HCl] is a reasonably effective sporicide and has been used at a concentration of 2.5% as a soak to disinfect hides potentially contaminated with anthrax spores before tanning. As an example that all disinfectants materials are not uniformly effective, it should be noted that sulfuric acid [$H_2SO_4$] is NOT sporicidal. **SAFETY NOTE**: When acids are to be diluted, *always add the acid to water and never add water to the acid.*

***Organic Acids***—the organic acids are as effective as the mineral acids without being nearly as corrosive. Citric acid is readily available in the food industry and has been used alone or as an additive to detergents to disinfect for FMD virus. Acetic acid (5% white vinegar) is being routinely used to wipe down horses coming into the United States from countries representing an FMD risk to assure that they are not carrying FMD virus on their coats.

**Alkalis**—the hydroxyl ion ($OH^-$) inhibits or kills most bacteria and viruses when the pH is greater than nine. Alkalis are effective against all organisms with the exception of non-enveloped viruses and bacterial spores.

***Sodium Hydroxide***—commonly called caustic soda or lye, sodium hydroxide (NaOH) is one of the most common alkalis used as a disinfectant. Its use as a permitted disinfectant is recognized in 9 CFR §71.10 (a) (4) which recommends preparing sodium hydroxide (lye) in a fresh solution in the proportion of not less than one pound of not less than 95 % purity in 6 gallons (22.7 L) of water, or one 13.5 oz (400 mL) can to 5 gallons (18.9 L) of water. Due to the extreme caustic nature of sodium hydroxide solution, wear protective clothing, such as rubber gloves, boots, raincoat, and goggles. Keep an acid solution such as vinegar readily available in case any of the sodium hydroxide solution should come in contact with the body. The proportions listed provide a working solution of 2% which is sufficient for most disinfectant uses. However, sodium hydroxide is not sporicidal unless it is used at a concentration greater than 5%. **SAFETY NOTE**: This material is *extremely caustic* and must be used with great care. When mixing, *always add lye to water, never add water to lye.*

***Anhydrous Sodium Carbonate***—Soda ash, anhydrous sodium carbonate [$Na_2CO_3$] is a very good cleaning agent. A 4% weight/volume (w/v) solution (1lb/3 gal [0.454 kg/11.4 L] of water) is used for washing vehicles and is currently used for cleaning the hooves of horses being imported into the United States. With the addition of 0.1% sodium silicate, 4% sodium carbonate is the only disinfectant currently recognized for use on aircraft. Title 9 CFR§91.41 gives specific instructions for aircraft disinfection: "Prior to loading of animals, the stowage area of aircraft to be used to export animals under the provisions of this part shall, under the supervision of an inspector, be cleaned and then disinfected using a freshly prepared solution of 4 percent sodium carbonate plus 0.1 percent sodium silicate."

***Hydrated Sodium Carbonate***—Washing soda or Sal soda, which is hydrated sodium carbonate [$Na_2CO_3 \bullet 10\ H_2O$], is commonly sold as a cleaning agent. It has 10 water molecules attached to each molecule of sodium carbonate making a molecular weight of 152 gm rather than the 52 gm molecular weight of anhydrous sodium carbonate. To get the same level of disinfectant activity using hydrated sodium carbonate would require roughly three times the weight of dry product.

***Calcium Hydroxide***—Air-slaked lime or calcium hydroxide [CaOH] has been used as a disinfectant and is reasonably effective against many non-spore formers. When mixed with water, it forms hydroxyl ions and liberates heat [$CaO + H_2O = Ca(OH)_2 + HEAT$]. Although it is not sporicidal, it has been used to disinfect premises. A 20% suspension is commonly used as whitewash.

**Biguanides**—are a class of disinfectants which are mild enough to be used as antiseptics on skin. One of the most common, chlorhexidine, has been used as a cattle teat dip for many years. Chlorhexidine is a very effective bactericide but of only limited usefulness otherwise. It is completely ineffective against non-enveloped viruses, acid-fast bacteria, and bacterial spores.

**Halogens—**members of the halogen group are effective disinfectants when proper cleaning has been done prior to their use. Unfortunately, the halogens are ineffective in the presence of organic matter. Halogens are more effective at an acid pH, and they are highly toxic for aquatic animals; great care must be taken to never discharge them into a watershed. If discharge into a watershed cannot be avoided, the halogen should be neutralized with sodium thiosulfate at the rate of five moles thiosulfate to four moles of halogen. Further information on neutralization of halogens can be found at http://www.oie.int/.

***Sodium Hypochlorite***—commonly sold as household bleach, sodium hypochlorite [NaOCl] is available in the grocery store and as a swimming pool chemical. Chlorine solutions decompose fairly rapidly when they are exposed to heat or light. The stock solutions also tend to lose strength when stored for long periods even in the absence of heat or light. Chlorine is highly sporicidal and mixing it 50-50 with a solution of one-half alcohol/one-half water enhances this effect. Chlorine containing compounds are very corrosive.

***Calcium Hypochlorite***—Chlorinated lime or calcium hypochlorite [$Ca(OCl)_2$] is another material mentioned in 9 CFR §71.10 (a) (3) as a permitted disinfectant. Title 9 CFR §71.10 (a) (3) recommends using chlorinated lime (U.S.P. strength, 30 percent available chlorine) in the proportion of 1 pound to 3 gallons of water.

***Iodine***—Iodine is less reactive than chlorine. Iodine dissolves readily in alcohol but it is necessary to add potassium iodide to water solutions in order to dissolve appreciable levels of iodine. As a disinfectant, the spectrum of activity of iodine is similar to chlorine. Iodine is less effective against the non-enveloped viruses than chlorine. However, in the presence of organic matter, iodine is more effective than chlorine.

**Oxidizing Agents—**provide oxygen to form an oxide. Chemically, oxidation is the increase of positive charges on an atom, or the loss of electrons.

***Hydrogen Peroxide***— Peroxides are compounds containing a high proportion of oxygen bonds. When fresh, hydrogen peroxide [$H_2O_2$] solution is an effective disinfection agent, except in the case of non-enveloped viruses, spores and the acid-fast bacteria where its effectiveness is questionable. The active agent in disinfection is the hydroxyl free radical (•OH) which destroys microorganisms through DNA strand breakage and the destruction of enzymes. Since commonly available solution of hydrogen peroxide break down quickly, ensure that solution is fresh. Stabilizers are now being added to some commercial hydrogen peroxide.

***Peracetic Acid***—in its pure form, peracetic acid [$CH_3C(O)OOH$] is an extremely shock sensitive explosive. It is supplied as a 40% solution in acetic acid which has an open cup flash point of 40.5°C, and it will spontaneously explode when heated to 230° F (110°C). Modern

stabilized disinfectants using peracetic acid are generally mixtures of peracetic acid, hydrogen peroxide, and acetic acid. The level of active ingredient in mixed peracetic acid disinfectant solutions is generally **.**25% or less. Peracetic acid alone or with hydrogen peroxide is one of the high level disinfectants cleared by the Food and Drug Administration for processing reusable medical and dental devices. Peracetic acid is an effective sporicide.

***Virkon S***®—is very convenient to handle, because it is supplied as a water-mixable powder. Virkon S® is a buffered peroxymonosulfate compound modified with the addition of surfactants and organic acids. In 1% solution, it has a pH of 2.6 and thus would be effective as an acid disinfectant if this were its only mode of action. With the additional activity of the oxidizer, it can be expected to be effective over a broad spectrum of organisms.

The Material Safety Data Sheet (MSDS) indicates that in 1% solution Virkon S® is non-irritating to skin or eyes. There is no occupational exposure limit specified on the MSDS. Company literature indicates that at dilutions encountered in normal working solutions, the ingredients are decomposed or biodegraded and are comparatively harmless.

According to company data, the 1% solution has a 10% loss of initial activity after 7 days in 350ppm hard water and the powder form has a 2.3% loss of initial activity after 36 months at 68° F (20°C). Packages of dipsticks are available to check the strength of working solutions of this product. **SAFETY NOTE**: The powder is corrosive and will cause skin burns and irreversible eye damage. It is harmful if swallowed, absorbed through the skin, or inhaled. Wear impervious gloves, goggles and respiratory protection when handling the powder. Virkon S® in its powder form should not be subjected to high temperatures because, when heated to 158° F (70° C), it will decompose and create toxic sulfur dioxide gas.

**Aldehydes—**these chemical compounds have the general formula RCHO. The R group may be aliphatic or aromatic. The aldehydes contain the carbonyl group C==O. It is the carbonyl group that determines the chemistry of aldehydes. The aldehydes are very effective against bacteria and enveloped viruses. They are somewhat effective against non-enveloped viruses, bacterial spores, and acid-fast bacteria.

***Formaldehyde***—a gas at room temperature, formaldehyde [H-COH] is commonly used as an area disinfectant in poultry houses and incubators. The gas dissolves readily in water to form a solution called formalin which consists of 37% weight/weight (w/w) formaldehyde $CH_2O$ in water with 10% methanol added to improve stability. Formaldehyde combines readily with proteins. The presence of organic matter decreases its effectiveness.

***Glutaraldehyde***—an oil at room temperature, glutaraldehyde [CHO-$CH_2$-$CH_2$-$CH_2$-CHO] is stable at an acid pH and is "activated" before use by increasing the pH to greater than 7, as the efficacy depends on the pH. To avoid decomposition, do not raise the pH over 9. Organic matter has little effect on the disinfectant properties of Glutaraldehyde.

**Surfactants—**Surfactant molecules have a hydrophobic and a hydrophilic region. The hydrophilic or polar region has an affinity for water. The hydrophobic or hydrocarbon region is water repellant.

***Cationic***—Cationic surfactants include the quaternary ammonium compounds (QAC). QAC are very effective against gram-positive bacteria, effective against gram-negative bacteria, limited in their effectiveness against enveloped viruses and not at all effective against the non-enveloped viruses. These compounds are not mycobactericidal, not sporicidal and even some bacteria, such as *Pseudomonas aeruginosa,* are not susceptible to their action. The QAC are more effective when the pH of the solution is greater than 7. The QAC are very adversely affected by organic matter, and their usefulness on farms is limited.

***Anionic***—Anionic surfactants are strong detergents, but very weak disinfectants. Examples include alkali-metal and metallic soaps as well as products such as sodium laurel sulfate which is found in many shampoos.

***Non-ionic***—Non-ionic surfactants have little disinfectant activity and are probably most important because they reduce the effectiveness of other antimicrobial agents.

***Amphoteric***—Amphoteric surfactants have bactericidal activity over a wide pH range. They combine the detergent qualities of the anionic surfactants with the bactericidal properties of the cationic surfactants. Some amphoteric surfactants have been used as disinfectants in the food industry for many years.

**Alcohols—**Alcohols have the general formula (ROH) in which R is an alkyl or substituted alkyl group. The hydroxyl group (–OH) is the functional group and determines the properties of this family. Ethyl alcohol ($CH_3CH_2OH$) is undoubtedly one of the earliest produced and most widely used alcohols. Ethyl and isopropyl alcohol are sold as rubbing alcohol and used on the skin as antiseptics. Antiseptics inhibit the growth of microorganisms and, unlike disinfectants, are safe enough to use on living tissue. Some water must be present for alcohol to act as an antiseptic, and most rubbing alcohol is sold as 70% alcohol and 30% water, a mixture which provides the greatest antiseptic activity. Alcohol is very effective against bacteria, effective against enveloped viruses and acid-fast bacteria, but is ineffective against non-enveloped viruses. Alcohol is not sporicidal by itself but it potentiates the sporicidal effect of hypochlorites (See sodium hypochlorite for sporicidal formula).

**Heavy Metals—**Heavy metals are little used as veterinary disinfectants, but there are some examples of their use that might be of interest. Organic mercury is active against bacteria and mold, although it is not sporicidal. Silver nitrate has been used on burns. Zinc salts are a mild antiseptic. Copper salts are used as preservatives and as a topical treatment of foot rot in sheep.

**Dyes—**Dyes such as trypan red and the flavines were among the earliest attempts at finding drugs which would combat microorganisms. Acridine dyes such as proflavine and aminacrine are used as topical antiseptics although they are slow in their action and not sporicidal. Triphenylmethane dyes such as crystal violet, brilliant green, and malachite green are also used as topical antiseptics. Quinones are natural dyes and some are powerful agricultural fungicides such as chloranil and dichlone.

**Gaseous Disinfectants—**those disinfectants that are in a gaseous form at normal room temperature and atmospheric pressure.

***Ethylene Oxide***—A flammable, water-soluble gas, ethylene oxide [$C_2H_4O$] penetrates paper and cellophane easily. It is not corrosive and can be used on delicate instruments and electronic equipment. It is commonly used for sterilization of delicate surgical instruments. Some moisture must be present (70% humidity is ideal) for ethylene oxide to work effectively.

***Propylene Oxide***—Similar in many ways to ethylene oxide, propylene oxide [$C_3H_6O$] is less active and penetrates poorly. Therefore, it does not effectively disinfect packaged items. Some moisture must be present.

***Formaldehyde***—Covered above under Aldehydes. Some moisture must be present for formaldehyde to work effectively.

***β-Propiolactone***—This gaseous disinfectant has been used as an inactivating agent in the production of viral vaccines. There is some evidence that it may be carcinogenic to animals.

***Methyl Bromide***—routinely used as a fumigant for soil, grain and large structures, methyl bromide [$CH_3Br$] is extremely toxic and dangerous to use.

***Ozone***—a hyperactive molecule, ozone [$O_3$] has been used as a disinfectant to purify water where it is used at the rate of .2 – 1 mg/liter for 3 minutes.

## Chapter 4 Premises Cleaning

C&D Unit personnel may be called upon to supervise the C&D of premises or to actually perform the cleaning and disinfection functions. The decision to commit resources to C&D of premises is to be made at Incident Command level. If the C&D Unit is to perform the C&D, a team should be assigned to the premises immediately following confirmation of diagnosis. The team can make their logistical preparations while depopulation and disposal occurs and arrive on premises in time to perform C&D on all vehicles, equipment, and personnel leaving the premises.

### Personnel Requirements

When C&D Unit personnel are called upon to perform the C&D function, the number of personnel required to C&D premises will vary depending upon the total number of buildings, size and separation of the buildings, size of the area, sanitary conditions of the premises, and the timeframe within which the work is to be performed. One or more C&D team of about 10 persons each is recommended for disinfecting large farms and stockyards or sale barns. Each team will be supervised by a C&D Team Chief who reports to the C&D Team Manager. The Team Chief is responsible for securing the necessary equipment and supplies, for scheduling work, and for certifying work accomplished on the affected premises. When more than one team is assigned to premises, there will be a single Team Chief in charge of the operation.

**Supervision of C&D**—When it is determined by the Incident Commander that only supervision of the C&D process will be provided, supervision teams of two or three knowledgeable C&D Team members should be assigned several premises that are in approximately the same stage of C&D. During the cleaning process, while the premises are still infected, the team can move among premises that are at the same stage of C&D providing supervision and guidance. When premises have been cleaned and are ready for disinfection, one or two C&D Team members will then spend the day or two required to supervise the application of the disinfectant. Once application of disinfectant has been started, the premises should be treated as “clean” and there must be no further movement from other premises that would not be appropriate when moving to any “clean” premises.

**Contractors**—When contractors are being hired by the owner/manager to accomplish specific parts of the C&D process, (e.g., use of a “bobcat” loader to remove material during the dry cleaning), C&D supervisors should be especially vigilant to ensure that equipment and personnel are cleaned and disinfected before moving to other premises. If the contractor is moving the same personnel and piece of equipment to other infected premises, the level of concern would be reasonably low. Even so, completing C&D of the equipment and personnel and escorting any contractors from premises to premises is absolutely necessary. If the equipment is to be used in any other situation, complete C&D with very careful inspection should be accomplished. If the personnel are to be used on “clean” premises, they should undergo personal decontamination and understand and comply with necessary restrictions on their contact with “clean” animals.

## Equipment and Supplies

**High pressure washers—**These pumps are precision units which must be maintained and operated by persons who are thoroughly familiar with their use and care. If they do not get reasonable attention, they will fail in service after only a few hours. Special oil is used in the pumps and overfilling a pump reservoir is almost as damaging as running it with too little oil. Without careful attention, pumps are subject to damage by the often corrosive chemicals used for disinfection.

When finished with an operation, never leave mixed solutions in a pump even for a few hours. If the instruction manual supplied with the pump does not have specific instructions for the use of corrosive solutions, at the end of the workday run 2 to 3 gal (7.5 to 10 L) of clean water through the pump and then run a gallon (3.78 L) of warm water with an ounce or two of light mineral oil or liquid detergent through the pump.

**Proportioners**—These mechanical devices will dispense a specific amount of stock solution (disinfectant or cleaning agent) for each unit of water that is pumped through. If a proportioner is used on the output side of a pump, the mixed solution will not be in contact with the internal parts of the pump.

In very simple proportioners, water is pumped through a venturi-style flow meter and a suction line supplies the liquid to be mixed to the low pressure area of the flow meter. While simple and inexpensive, venturi-style proportioners have limited application because they used fixed ratios of stock solution; therefore, they do not do a good job of maintaining the mix ratio over a wide range of flow rates.

More expensive proportioners are available which have changeable nozzles providing off-the-shelf admixtures from 0.4% to 1% at flow rates of 53 gal/minute (200 L/minute) up to 106 gal/minute (400 L/minute), which is far above the thru put of most high pressure washers. A company specializing in proportioners can machine special nozzles for specific dilutions. Such companies can be located on the Internet.

**Clothing—**The C&D Team Chief and the Team Members who will be cleaning with high pressure washers or applying disinfectants will be supplied with protective rubber outfits, including boots, coat, pants, hat, and gloves. Other members engaged in hand cleaning operations will be provided with coveralls, boots, hats, gloves, and masks. Respirators will be provided as needed. At the end of each day's work, all outer garments will be removed and left on the premises.

During adverse weather conditions, special clothing will be provided and either soaked in a permitted disinfectant or fumigated with an approved gas before removal from the premises. After being soaked 12 hours in permitted disinfectant, coveralls may be removed from the affected premises in a closed container, (plastic bag) washed, and reused. Items necessary for a C&D team to function efficiently are listed in Appendix III.

In order to achieve satisfactory fitting, the required protective clothing will be issued to each individual on the team by the Supply Unit. Additional supplies of consumable item for the team members (e.g., gloves, masks, and disposable coveralls) should be available outside the affected premises.

**Entrances**

The C&D Team should collaborate closely with the Biosecurity Team that is assigned to maintain security for the premises. The Biosecurity Team should make sure all entrances to the premises except for the monitored one are securely closed.

Equipment for C&D of personnel moving to or from the premises should be available at the entrance. A tent, metal shed, trailer with shower, or other shelter should be available for changing clothes. Equipment and materials for C&D of trucks and heavy equipment leaving the premises should be available in a suitable work area to expedite movement.

**Cleaning**

Cleaning is the most important step in the disinfection process. If an item or material is not adequately cleaned, the application of disinfectant is a waste of time and money because soil (manure, dirt, secretions, and excretions) cannot be disinfected. The cleaning process can be broken down into four basic steps: (1) dry clean; (2) wet wash; (3) rinse; and (4) dry. After these steps have taken place, the area should be carefully inspected to be sure it is absolutely clean before the disinfectant is applied.

Once the animals and all animal products are gone, the premises can be divided into a clean and dirty area as the process of C&D progresses. The clean area should initially begin at the entrance to the premises and be gradually extended to include sufficient parking area for the various vehicles that come to the premises or that are cleaned, disinfected and moved from the dirty area. A parking area for the vehicles on the clean side should be well drained and free of mud.

Products of animal origin should be disposed of, and the area where those products were kept or stored must be cleaned and disinfected before the premises quarantine can be released. Satisfactory C&D will assure that no animal excretions or secretions remain since they can harbor disease.

Enough vehicles should be left on the dirty side of quarantined premises to ensure that the work can proceed efficiently. While moving a clean vehicle back to the dirty side to improve efficiency is really not a great loss in terms of the total project of cleaning the premises, it may make those doing the cleaning feel that they have lost ground. It is better not to have moved the vehicle to the clean side in the first place.

During the time that there are clean and dirty areas on the premises, those areas should be separated using plastic tape so that the lines are not inadvertently crossed while working. The clean and dirty areas should be large contiguous areas that do not block a normal flow of traffic or work.

The movements or people are the most difficult to control in dealing with a quarantine premises. There will always be the tendency to just step over the line to get a needed tool or save a few steps on the way to somewhere else. Dividing lines should be placed to make it as easy as possible to follow the guidance. Areas should not be changed from dirty to clean until it makes logical sense to effect the change over. Plan the areas to make it easy for persons who must work on the premises to follow the rules rather than making it a challenge. If it will impede work to include a new area in the clean portion of the premises, leave it designated dirty until a larger, more logical area can be included in the clean area. The clean area can be gradually extended to include most of the premises with the animal housing being the very last dirty area to be evaluated and certified clean.

**Dry Clean—**The area to be disinfected should be dry cleaned with a shovel and broom. This step will remove all gross contamination with manure, debris, loose straw, and feed. Any material that cannot be burned should be buried. Scrap wood, wooden gates, wooden feed bunks, and items that are of limited financial value compared to the time and effort required to clean them should be gathered together to be appraised and burned. Ropes, halters, and other items of minimal value that are difficult to clean and disinfect should be appraised and burned.

Begin the process by hauling the manure to a predetermined site for disposal. This may involve moving a number of tons of manure and require considerable time. Stalls, barns, and stanchions that cannot be cleaned out with tractors must be cleaned with manure fork, shovel and broom.

When the dry cleaning step is finished, there will be no loose dirt, dust, feed, bedding, manure, hay, straw or any other loose organic material left within the structure. The surfaces will not necessarily be visibly clean when this step is complete because of organic matter which is tightly adhered to the surface.

**Wet Wash—**All exposed surfaces, cracks, junctions, joints and mechanical items should be wet washed with a soap solution or detergent. During the wet wash it is necessary to scrub, scrape, or wire brush all surfaces vigorously to break down any biofilm which may be present. Scrubbing can be done with rags on smooth surfaces although commercially available plastic or metal scrub pads are much more efficient. Rough surfaces should be scrubbed with a wire brush to ensure that they are cleaned as completely as possible. Deep cracks, crevices, pits, pores, or other surface irregularities should be given special attention to dislodge accumulated grime. When the wet wash step is completed, the surfaces will be visibly clean. The moisture on surfaces will spread evenly, wetting the surface completely. There will be no beading of moisture which would indicate the presence of oil or grease.

***Hot Water—***If hot water is not available, assign one or more persons to heat water for washing. Soda ash is a very effective detergent material to use in the wet washing step but the water

temperature must be 95°F (35° C) or higher for the sodium carbonate to dissolve. It may be necessary to build a fire pit with old blocks, bricks, or rocks. Fifty-five gal (208 L) drums cut in half make excellent containers for heating water.

***Electrical equipment*—**Special care should be taken around electrical equipment. Bring in a number of independent lighting units and turn off electrical power if there is danger of getting cleaning solutions into fixtures. Have the owner contact an electrician for removal of thermostats, timing devices, motor controls, and remote sensing equipment prior to wet washing.

***Milk parlor***—Extreme care must be used in cleaning a milk parlor. The owner should be encouraged to assist and supervise this operation to prevent damage to equipment. This is an extremely important area since infected animals may have been milked the day of the diagnosis and virus from lesions (teats, feet and mouth) as well as virus secreted in milk will have seeded the area. Special care should be used when cleaning and disinfecting all rubber equipment. Strongly consider requesting an appraisal of these items and destroying them.

**Rinse**

Rinse washed surfaces thoroughly to remove all traces of soap or detergent. Residue of soap or detergent should not be left on the surface because it may react in an unfavorable manner with the disinfectant. When this step is complete, the water film will still "wet" the surfaces in the absence of soap or detergent, and there will be no beading.

**Dry**

The rinsed surfaces should be dried to remove all of the moisture. Removing the moisture promptly will protect equipment and surfaces from deterioration. If left in place, excess moisture will dilute the disinfectant which is to be applied to the surfaces and there is no practical way to compensate for the dilution when mixing the disinfectant. In cool or cold weather, drying can be accomplished by heating the building and circulating the air with auxiliary blowers. In hot weather, drying can be accomplished with blowers or fans alone. In confined areas or on equipment where air circulation from fans is not enough, the use of high pressure air from a compressor or high volume "leaf blowers" will remove excess moisture so drying can take place.

**Inspect**

All surfaces, junctions, cracks, and mechanical devices in the building should be carefully inspected to assure that the cleaning process has removed all of the organic matter. Rewash any areas that may require further attention in order to pass inspection.

## Chapter 5 Premises Disinfecting

Disinfecting is the process of using an agent or chemical that destroys or removes vegetative forms of harmful microorganisms in an area or on a surface. Over time, multiple repetitions of C&D might reach the point of sterility but from a practical point of view the aim when disinfecting is to diminish the population of microorganisms to a level where they are not harmful, not eliminate them entirely. It is entirely impractical to consider each instance of C&D to be an exercise in sanitizing.

### Selecting a Disinfectant

Selecting a suitable disinfectant is a complicated process. As a first step, using the information already provided above, select a family of disinfectants which will be effective against the microorganisms of interest. In making this choice, the primary concern is that the disinfectant being considered will function effectively in the environment where it will be used. Most disinfectants will not work very effectively in the presence of organic material, but some are better than others in this respect. Choosing a disinfectant that will work in the presence of organic matter will provide an extra margin of safety in case the cleaning process is not perfect.

After choosing a family of disinfectants, determine which companies offer EPA approved disinfectants that contain the active agent selected. Obtain label information on each possible disinfectant from the internet to determine dilution requirements and check to see that the company's EPA approved label indicates effectiveness against the microorganism of interest.

Be sure that the products being considered are available in concentrated form so that the material can be reasonably transported. There are excellent products on the market which are supplied only in final application dilution. Choice of such a product would mean the shipment and handling of thousands of gallons of solution in the case of a large task force operation. Because of the logistical problems of handling large volumes of liquids, products that are available as concentrates will always be favored. Check with the company or their distributors for availability and shipping information.

Products which are solids in their concentrated form have a number of advantages. Shipping costs are minimized. Solid products do not freeze in cold weather which makes the handling and storage much easier. Also, solid products can be weighed out in pre-measured packets for use in the field.

### Mixing

Most disinfectants are supplied as concentrates which can be added to water to make a working solution for application. When using a 1% solution, this makes it possible to transport only one pound (0.454 kg) of liquid concentrate or 13 oz (0.369 kg) of powder concentrate to mix 10 gal (37.8 L) of working solution rather than transporting 80 lbs (36.3 kg) of working solution. The weight of a liquid concentrate will vary depending on the concentration of active ingredient.

Concentration of solutions is expressed in a number of different ways. Molarity or moles (gram molecular weight) of solute to volume of solution is used in chemical calculations. While this allows very accurate calculation of the quantitative relationship between constituents in chemical reactions, such a high degree of accuracy is not needed in most C&D operations.

Materials used in very dilute concentrations are often expressed in parts-per-million (ppm). For example, the recommended concentration of chlorine for disinfection of non-porous food contact surfaces is 100 – 200 ppm, for porous food contact surfaces 600 ppm and for nonfood surfaces, 600 – 1000 ppm. In order to convert from the concentration expressed on a label as 5.75% to ppm multiply by 10,000. For example, 5.75% bleach available from the grocery contains 57,500 ppm sodium hypochlorite.

EXAMPLE: To mix 250 gallons of a solution for application containing 1000 ppm from a concentrate with 5.75% sodium hypochlorite [NaOCl]:

$$\text{Sodium hypochlorite concentrate to add} = \frac{1000 \text{ ppm} \times 250 \text{ gal (946 L)}}{5.75\% \times 10{,}000} = 4.35 \text{ gal (16.5 L)}$$

NOTE: pH of the solution must be adjusted to between 6.5 and 7.5 to insure that the chlorine is in the form of "free chlorine"

Concentration expressed in percent values are expressed as volume/volume (v/v) when the solute is a liquid or w/v when the solute is a solid. When mixing highly toxic materials to be used in therapeutic situations, the difference between w/v and v/v can be very important. However, when mixing bulk solutions for disinfecting, the difference is almost insignificant. One ounce in dry measure is 28.350 gm while one fluid oz of water is 29.573 gm. The difference in weight amounts to 1.223 gm or .043 oz. Most persons mixing working solutions in the field will be unable to maintain this level of accuracy, and there is a natural tendency to heap the measuring vessel.

If powdered concentrate is to be weighed out in prepackaged containers for use in the field, the correct weight for a 1% solution mixed from a solid is 1.323 oz (37.5 gm) of solute per gal (3.78 L). Heavy duty postal scales can be used to weight out prepackaged portions of 13 ¼ oz (277.4 gm) to be added to each 10 gal (37.8 L) of working solution.

The use of testing kits is highly desirable to control for possible aging and degradation of chemicals in the concentrated form. Testing kits are available for "free chlorine" but this information must be combined with pH information to know if the chlorine is in the form of pathogen-killing hypochlorous solution. If a kit for measuring chlorine in swimming pools is used, it is necessary to perform a dilution of the 1000ppm disinfectant solution to bring it into the range of 1 – 5 ppm, which is the normal range measured by such kits.

EXAMPLE: To dilute a sample of 1000 ppm (?) disinfectant working solution to 2 ppm:

**V1 x C1 = V2 x C2**

$$\frac{\text{1 ml of disinfectant working solution x 1000 ppm}}{\text{2 ppm}} = \text{500 ml final volume}$$

Therefore, add 1ml of disinfectant solution to 499 ml of distilled water.

**Dilution**

The dilution of the disinfectant raises legal, economic, and safety issues.

**Legal**—The EPA approves the use of the disinfectant exactly as stated on the label. The dilution listed on the label must be followed exactly unless there is a Section 18 exemption which allows a different dilution. Failure to follow label directions makes the individual and the supervisor liable. See Appendix VII for those chemical agents used as disinfectants which are approved under FIFRA Section 18 for use against OIE List A foreign animal diseases.

**Economic**—It it is also most cost-effective to mix disinfectants exactly as specified on the label. Disinfectants are tested and proven effective at the specified dilution. The "glug" method of measuring is unacceptable.

**Safety**—In most cases, higher concentrations of disinfectants are more dangerous to personnel. Supervisors and all personnel should follow all dilution instructions to avoid occupational injury and health problems.

**Application**

The application of the disinfectant should be done according to label directions. *Disinfectant wet time* should be observed carefully. A surface to be disinfected should remain "shiny" wet for at least 10 minutes, merely damp is not adequate. Porous and rough surfaces will require more disinfectant than smooth surfaces. Since a heavy application of disinfectant which runs off and puddles on the floor is not effective or efficient, a second light application of disinfectant is one way of keeping the surface wet for the required time.

**Downtime**

The period of downtime can begin as soon as the premises can be certified as clean and disinfected. The period of downtime should be at least three times the longest expected incubation time of the disease in question. Downtime is a period during which the premises can dry out completely from the disinfection process and the numbers of any remaining microorganisms can be expected to decline to a point where there is little or no possibility of infection of susceptible animals.

After the cleaning process, disinfection provides progress toward complete elimination of an infectious microorganism and downtime provides further progress after disinfection. It is an absolutely necessary part of the process because disinfection is not the same as sterilization. Disinfection is intended to reduce the number of microorganisms so that they are no longer infectious. The need to apply a solution of uniform concentration over huge areas, including ceilings, heating ducts, lights, plumbing, structural members, walls, and floors makes it very difficult to ensure that the process is always done to perfection.

## Chapter 6 Safety Issues

Individuals who handle and apply disinfectant should review pertinent education materials, including several web sites which contain self-study materials. All C&D supervisors should complete some web-based and on-site training. See "Internet Sites for Reference Material" in Chapter 10.

Some specific safety issues have been mentioned previously. Proper handling of concentrated acids or alkalis in regard to dilution appears on pages 14 and 15. In particular instances, reference has also been made to the use of personal protective equipment. It must be clearly understood that there is an inherent danger in all of the materials and processes presented in this document. *Consult the Safety Officer in case of doubt.*

### Worker Protection Standards

The Worker Protection Standards (WPS) are a specific portion of FIFRA (Title 40 CFR Part 170) which requires the protection of employees from agricultural pesticides (including disinfectants). Supervisors of individuals who will be applying disinfectants must read the label on the disinfectant closely and look specifically for references to the Worker Protection Standards. If the labeling refers to WPS, compliance is mandatory. Copies of "WPS How to Comply" may be obtained from local Cooperative Extension offices or from a web site such as http://pested.ifas.ufl.edu/pest_protect.html The use of any gaseous disinfectants requires a restricted entry interval under the WPS. One of the most significant parts of WPS requires the oral and written (posted sign) notification of workers when any location they have access to is being treated.

### Personal Protective Equipment

Whenever appropriate, use personal protective equipment, such as boots, coveralls, rain suits (including both pants and jackets with hoods), gloves specific to the materials being handled, face shields when applying disinfectants, and goggles when handling concentrate powders or solutions. Respirators and chemical-resistant suits may be required for some solutions. During all C&D operations, respirators should be available if the personnel are at risk from a disease organism or chemical hazard, if significant amounts of dust are generated, or upon individual request. (For further information on respirators, see the APHIS Respirator Program Guidelines in APHIS' "Safety and Health Manual," Chapter 11, Section 3.) The APHIS Safety and Health Manual is available at: http://www.aphis.usda.gov/mrpbs/manuals_guides/safety_health_wellness_manual/index.html. The Incident Command Staff Safety Officer should be consulted as necessary.

**Hazard Communication Standard**

The Hazard Communication Standard (HCS) is the program administered by the Occupational Safety and Health Administration of the U.S. Department of Labor. The HCS provides protection for employees who may be exposed to hazardous chemicals under normal work conditions or possible emergencies. The standard requires employee training, that containers be labeled, that employer collect a MSDS on each chemical used, that a list of all hazardous chemicals in the workplace be maintained, and that employers understand their responsibilities. The HCS is covered in 29 CFR 1910.1200. Further information on HCS can be found at http://www.osha-slc.gov/. Click on *Laws and Regulations – Standards* in the blue column on the right.

## Chapter 7 Cleaning and Disinfection Stations

C&D stations are an important part of the movement control imposed on an area where HCDs exists. Movement control at the entrance to infected premises or on highways between an Infected Zone and Surveillance Zone is provided by the Regulatory Services Unit. The C&D Unit is collocated with the Regulatory Services Unit to provide their services as necessary.

### Infected Zone

An infected zone is that area immediately around infected and contact premises. The border of the infected zone will extend for at least 6.25 miles (10 km) from infected premises and contact premises. In the case of mosquito-borne diseases, the border of the infected zone must be large enough to account for the movement of potential insect vectors and weather conditions, particularly the direction and speed of any prevailing wind. The perimeter of the infected zone will necessarily be fluid as new information becomes available. The size and shape of the infected zone will initially depend on a number of factors including; the disease agent, mode of transmission, species affected, geography of the area affected, livestock concentrations, weather conditions, type of farms, and the season. As the situation becomes better defined, further adjustments can be made taking into account the following factors: normal patterns of livestock movement; processing options (livestock and products); the distribution and movements of susceptible wild and feral animals, and the disruptive effect on non-risk commodities.

### Surveillance Zone

The surveillance zone is that area immediately around the infected zone. The surveillance zone may initially include the entire State or States that have infected farms or known contacts. This zone will be adjusted appropriately as epidemiological information becomes available and the extent of the outbreak is better known. The surveillance zone will be a line roughly parallel to the border of the infected zone and a minimum of 6.25 miles (10 km) outside the infected zone. The same factors that determine the placement of the border of the infected zone should be considered when placing the border of the surveillance zone.

Once the extent of the outbreak is understood, susceptible livestock can move within the surveillance zone with permit, but not out of the zone. Non-susceptible livestock or poultry can move both within and out of the surveillance zone with a permit. The permit will specify the route that may be used and any other special considerations such as C&D of the transport vehicle before loading, C&D of the outside of the vehicle as it leaves the premises, and C&D of the vehicle when it leaves the delivery point. Decisions about movement of non-susceptible livestock or poultry from an infected zone must be made at Incident Command level.

Movement Control can also be established by setting general policies for certain specific movements. For example, school children who are not resident on infected premises can be safely moved from residence to school by following the general policies of: 1) clean child;

2) clean clothes; 3) clean footwear; 4) no visits to animal facilities. Further evaluation and more stringent requirements would be in order for children resident on infected premises. Personnel with the C&D Unit will be called on to help make determinations of the safety of particular movements.

Control of the movement of people, animals, vehicles, products and equipment is critical to the maintenance of biosecurity during a disease outbreak or other animal emergency. Cleaning and disinfection provides the ability to make necessary movements safely and is vital to the success of the disease suppression effort.

**Privately owned vehicles**

Cleaning and disinfecting privately owned vehicles at a C&D station is a sensitive situation. Cleaning and Disinfection stations may be located on public highways in conjunction with quarantine checkpoints between an Infected Zone and Surveillance Zone or on private property (with owner permission) at a business.

Personnel conducting C&D at such locations should be properly educated and prepared to deal with the public. A working knowledge of the nature of the disinfectant being used will assist greatly in being able to assure the owner of a vehicle that the solution is properly mixed and will not damage the finish or metal parts of the vehicle. Copies of the MSDS for the disinfectant should be available to offer any private citizen who may request further information. Cleaning and Disinfection personnel should have the necessary equipment and fresh water available to offer the vehicle owner the option of having the vehicle rinsed to remove any possible residual disinfectant after the 10-minute “wet time” has elapsed. Very few drivers will object to having a free car wash if they can be assured that the solutions will not damage the vehicle.

**Vehicle Cleaning and Disinfection**

Proper C&D of a vehicle is a multi-step operation. It is just as necessary to properly clean the vehicle prior to disinfection as it is to clean a barn or other facility. The outside and cargo carrying areas of all vehicles should be pressure-washed with a suitable car washing detergent. Begin at the top and work toward the bottom of the vehicle. The degree of soil is usually heaviest toward the bottom of vehicles and runoff from the top can soak the lower areas before the operator reaches them. After washing, the vehicle should be completely rinsed and allowed to drip for at least 5 minutes before being disinfected.

Other than a suitable drip time, it is not necessary to dry the outside of vehicles before applying the disinfectant. The outside surfaces of vehicles are smooth and impervious to moisture. Dilution of the disinfectant by moisture clinging to the vehicle surfaces will be negligible. Disinfect the vehicle with solution mixed exactly according to label directions.

When a pressure-washer is used, the outside of most vehicles will not require dry cleaning but the inside of vehicles often will. Any cargo carrying area of the vehicle should be evaluated and dry cleaned as necessary before washing. The inside of passenger vehicles should be evaluated

and at the very least the floor mats should be removed, dry cleaned, washed (if possible) and disinfected.

Rinse the vehicle if the owner has expressed any concern about the corrosive nature of the disinfectant and its possible effect on the vehicle or vehicle finish. Having read the MSDS, personnel operating a C&D station will already be aware that the word “corrosive” appears with great regularity on material safety data sheets. Often the warning is in regard to the concentrate and not the working solution but the general public cannot be expected to make that distinction.

**Disinfectant Mats**

It is generally acknowledged that disinfectant mats, for vehicles to drive over or foot traffic to walk across, are not very effective. To make matters worse, the physical presence of the disinfectant mat gives a false sense of security since it appears that something effective is being done to reduce the spread of disease. In actuality, there is not enough “wet time” for the disinfectant to act on infectious agents while foot traffic is on the mat or while a vehicle rolls across the mat. The drying of the mat and contamination with road soil further degrades the usefulness of the mat. The only good point for disinfectant mats is that they increase awareness of the disease problem, making it more immediate and personal.

**Boot Pans**

Boot pans have the same basic problem as disinfectant mats. There is not sufficient “wet-time” for the disinfectant to do an adequate job. An added drawback to boot pans is that boots contaminated with organic matter (and possibly microorganisms) will leave behind a certain portion of the organic load to contaminate all following boots. Very few disinfecting areas have the equipment or supplies for proper cleaning of boots before walking through the disinfectant solution.

## Chapter 8 Personnel Disinfection

Once the situation has been stabilized and reasonable controls are in place, people and vehicles can leave the infected premises provided they can meet acceptable biosecurity standards. Casual traffic off of the premises, which will be returning, is to be discouraged. The amount of effort involved in C&D of persons and vehicles leaving infected premises will probably help to discourage unnecessary movement. No equipment or supplies that can carry disease should be allowed to move off of the premises from a quarantined animal production unit.

Persons who have been working in a quarantined animal production unit and who absolutely must leave the premises before euthanasia and disposal activities are complete should be subjected to a complete personal disinfection. Even after complete personal disinfection, persons who leave the premises must not come in contact with susceptible animals for a period of five (5) days. Personnel should certify this requirement in writing.

### Risks Posed by Visitors

Cleaning and disinfection personnel are likely to be asked for assistance in facilitating the movement of persons who have what they believe to be a real need to move around within the quarantine control area. Under normal circumstances visitors may enter premises for a wide variety of reasons—from social calls to reading the electricity meter, delivering fuel, delivering feed, or vaccinating an animal. Each visit provides an opportunity—however inadvertent—for the transmission of pathogens to premises animals and thus is of concern.

*During an outbreak situation, all visitors should be considered high risk—especially within a quarantine control area.*

When an animal disease outbreak occurs, a quarantine control area will be established. The quarantine control area is made up of the infected zone and the surveillance zone. Movement within the quarantine control area must be minimized, and only those movements absolutely necessary should be allowed. It is obvious that more stringent enforcement of this general rule should occur in the infected zone than in the surveillance zone. Public service companies and other businesses that serve the quarantine control area must be contacted and informed of the risks inherent in having any of their personnel moving around on premises with susceptible animal species. Often, visits are not necessary, and other arrangements can be made such as having the owner/manager of animal premises telephone in a meter reading. As a general rule, the closer a premises is to an infected premises, the greater the vulnerability to pathogen transmission and thus the greater is the necessity for implementation of rigorously controlled biosecurity and C&D measures. It would be hoped that individuals responsible for a premises located immediately adjacent to the border of a quarantined area would implement stricter measures than people on a premises located miles away. However, considering the multiple locations to which livestock typically are moved on their way to market, premises might be vulnerable to pathogen transmission even if it is located a considerable distance from a quarantined area (e.g., becoming infected from a passing truck that has breached quarantine).

**Disposable Outwear—**Within a quarantine area, it is recommended that all visitors, regardless of how low the risk level is perceived to be, wear disposable coveralls, boots, hats, and gloves during their visits to premises with susceptible species. Although disposable garments may seem expensive, they are much more economical in the long run than reusable outerwear (which must be safely handled, cleaned, and maintained in good condition).

## Chapter 9 Cleaning and Disinfection of Fomites

Highly contagious diseases can be spread to susceptible species in the following ways: (a) directly; (b) indirectly, via fomites (i.e., mechanical carrier contaminated with a pathogen but not infected or susceptible to it) and people or animals acting as fomites; and (c) via arthropod vectors that may serve either as fomites or as an important part of the life cycle of the agent.

The direct route of spread will have been eliminated by disposal of the susceptible animal population. Effective C&D will prevent the spread of pathogens by way of fomites. It needs to be clearly understood that C&D and biosecurity are not effective in the case of a pathogen spread by an arthropod vector.

Animal product processing premises may be placed under quarantine pending C&D because of having received animals or animal products from infected premises or premises suspected of being infected. During the period before C&D was completed, movements to or from such premises should be restricted to activities that are absolutely necessary at that time and all movements must meet acceptable biosecurity standards.

All products (milk, hay, crops, etc) from infected premises or quarantined animal production premises should not be permitted to leave. These products should be destroyed, consumed, or held for sampling and laboratory confirmation of their negative status before movement is allowed. In providing information to owners, to allow decision making, it should be emphasized that in the midst of an outbreak of animal disease, sampling and laboratory confirmation for extraneous materials may take a much longer period than would normally be expected since animal diagnosis will be the first priority.

Continued security of all the potential fomites located on the premises must be maintained until C&D is complete and the premises released from quarantine. The premises are contaminated and have the potential to be the source of spread of contamination to other locations and animals until everything on the premises has been evaluated, cleaned, disinfected, and released.

**Other animals on the premises—**Animals that are not susceptible to the FAD must not be disregarded. They are just as capable of acting as fomites and moving and infectious agent as are humans. Susceptible species will have been removed from the premises by the time C&D is underway. However, it is necessary to maintain careful control of the other species of animals which may carry infectious material from the dirty to clean areas on the farm or to other farms in the local area.

**Pets—**The ubiquitous dog or cat is so common as to be almost invisible to the average observer, but must be effectively cleaned and kept under strict control until the farm has been declared free of infection and the quarantine removed. The animals that are not susceptible to the disease agent should be thoroughly bathed to remove organic matter and the agent it may contain from the animal's coat. There have been cases where all of the extraneous animals on infected premises have been euthanized along with the susceptible species but this is very questionable practice

that is probably not in the best interest of the owner. *All* animals on premises should be carefully evaluated for possible susceptibility and infection. Pets or curiosity species that are not production animals may still be contaminated. Feral animals must be trapped or destroyed, and scavenger animals must be detected and dealt with appropriately.

## Chapter 10 References


Office International des Epizooties, International Animal Health Code, Paris, France (www.oie.int)

Safety and Health Manual - Animal and Plant Health Inspection Service, U.S. Department of Agriculture - Washington, DC: Government Printing Office, 1998. (www.aphis.usda.gov)

An Introduction to Infectious Disease Control on Farms - Bovine Alliance on Management and Nutrition 2001. (The Alliance is composed of representatives of the American Association of Bovine Practitioners, the American Dairy Science Association, the American Feed Industry Association, and USDA.)

Veterinary Epidemiology - Martin, Meek, and Willeberg - Iowa State, Ames, Iowa: 1987.

*On-Farm Biosecurity: Traffic Control and Sanitation* - Shulaw, W. P., D.V.M., and Bowman, G. L., D.V.M - Extension Factsheet. The Ohio State University Extension. VME-6-2001.

The Merck Veterinary Manual – Merck & Co., Inc, Whitehouse Station, NJ – 8th Edition 1998
Antiseptics and Disinfectants – Page 1846
Disposal of Carcasses and Disinfection of Premises – Page 1221

Disinfection in Veterinary and Farm Animal Practice - Linton, Hugo, Russell - Blackwell 1987 Yearbook Medical publishers – Chicago – Phone (312) 726-9733
(Out of print - but can still be found at libraries and on the used book market)

AUSVETPLAN – Australian Veterinary Emergency Plan –1966 - Operational Procedures Manual – Decontamination (1 of 6)

Title 9 Code of Federal Regulations
- Subchapter C – Interstate Transportation
  - Part 71 – General Provisions
- Subchapter D – Exportation and Importation of Animals (Including Poultry) and Animal Products
  - Part 91 – Inspection and Handling of Livestock for Exportation
  - Part 95 – Sanitary Control of Animal Byproducts

Foreign Animal Diseases - UNITED STATES ANIMAL HEALTH ASSSOCIATION, 1992, Appendix 4, page 412-415.


### Internet Sites for Reference Materials

**Disinfectants**

**http://www.biosecuritycenter.org**
**http://www.oie.int**

**Safety and Personal Protective Equipment**

**National Biosecurity resource center**

**www.biosecuritycenter.org**

**Personal Protective Equipment**

**National Agriculture Safety Database**

**http://www.cdc.gov/niosh/nasdhome.html**

**http://www.cdc.gov/od/ohs/manual/pprotect.htm**

**Federal Pesticide Laws**

**http://pmep.cce.cornell.edu/facts-slides-self/core-tutorial/module03/**

**State Agricultural Extension Services**

Examples of available information include The Ohio State University Extension Fact sheets "Biosecurity for Youth Livestock Exhibitors," "Biosecurity Fundamentals for Extension Personnel," "Disinfection in On-Farm Biosecurity Procedures," "Cleaning and Disinfection of Poultry Facilities," and "On-Farm Biosecurity: Traffic Control and Sanitation" (http://ohioline.osu.edu).

**Industry**

Resources such as the "Biosecurity Guide for Pork Producers" and "Security Guide for Pork Producers", for example, are issued by the National Pork Board in conjunction with the National Biosecurity Resource Center for Animal and Health Emergencies of Purdue University and the American Association of Swine Veterinarians. Other materials on disinfection can also be found at (www.biosecuritycenter.org).

**Agricultural Ministries or Departments of Other Countries**

Examples are seen in the Web sites of the United Kingdom's Department for Environment, Food & Rural Affairs (www.defra.gov.uk) (do a search with "disinfectant" as the keyword) and of the Canadian Food Inspection Agency (www.inspection.gc.ca; click on choice of language, "Foot and Mouth Disease," and "Farm Biosecurity…A Common Sense Guide)."

**Acronyms**

**APHIS —** Animal and Plant Health Inspection Service, a unit within the United States Department of Agriculture.

**C&D** — cleaning and disinfection

**CFR** — Code of Federal Regulations.

**CP —** Contact premises

**DHIA —** Dairy Herd Improvement Association

**FAD —** Foreign animal disease

**FADD —** Foreign animal disease diagnostician

**FIFRA –** The Federal Insecticide, Fungicide, and Rodenticide Act.

**FMD —** Foot-and-Mouth disease

**HCDS —** Highly Contagious Diseases

**IP —** Infected premises

**MOU —** Memorandum of Understanding

**NAHEMS** — National Animal Health Emergency Management System

**OIE —** Office International des Epizooties

**SP —** Suspect premises

**TDD —** Telecommunications device for the deaf

**USC —** United States Code

**USDA** — United States Department of Agriculture

**VS —** Veterinary Services is a unit of the Animal and Plant Health Inspection Service.

## Glossary

**Aliphatic compounds—**Open-chain compounds and those cyclic compounds that resemble the open-chain compounds.

**Alkyl group—**A chemical group having the general formula $C_nH_{2n+1}$, for example: $CH_3$ – methyl; $C_2H_5$ – ethyl; $C_3H_7$ – propyl; $C_4H_9$ – butyl; etc.

**Animals—**Livestock, poultry, and all other members of the animal kingdom, including birds whether domesticated or wild, but not including man (9 CFR 53).

**APHIS—**The Animal and Plant Health Inspection Service, a unit within the United States Department of Agriculture.

**Aromatic compounds—**Benzene and compounds that resemble benzene in chemical behavior.

**Arthropod vector—**A member of the phylum Arthropoda (e.g., insects) that can transmit a pathogen from one host animal to another.

**Antiseptic—**A material that inhibits the growth of microorganisms and unlike disinfectants are innocuous enough to use on living tissue.

**Autoclave—**A vessel within which pressure and temperature can be manipulated for specific purposes.

**Carbonyl group—**A compound that contains a carbon-carbon double bond or a carbon-oxygen double bond.

**Cleaning and disinfection (C&D**)—Practices involving a combination of physical and chemical processes that kill or remove pathogenic microorganisms—a combination that is vital for the eradication of disease.

**Contact premises—**Premises related by sound epidemiological evidence to a known infected premises but where the disease has not been diagnosed.

**Destructive distillation—**Heating of a solid such as coal, wood or oil in a closed retort to decomposition temperatures so that the volatile products can be collected.

**Disinfect—**To free from pathogenic organisms or to render them inert.

**FIFRA—**The Federal Insecticide, Fungicide, and Rodenticide Act is administered by the Environmental Protection Agency.

**Glossary**

**Fomites—**Inanimate objects or material on which disease-producing agents may be conveyed (e.g., feces, bedding, or a harness).

**Foreign Animal Disease Diagnostician (FADD)**—A veterinarian who has been through the APHIS foreign animal disease training course at Plum Island and receives continuing education in foreign animal diseases and animal health emergency management.

**Fractional distillation—**Collecting distillation products which vaporize at different temperatures.

**Highly Contagious Diseases (HCDs)—**diseases that spreads rapidly from animal-to-animal as well as herd-to-herd. Transmission can occur via direct and indirect modes. HCDs may be recognized by above normal morbidity or mortality per unit time where morbidity could be characterized as a loss of production.

**Incubation period—**The longest period which elapses between the introduction of the pathogen into the animal and the occurrence of the first clinical signs of the disease. (OIE)

**Infected Premises (IP)—**A premises on which HCDs or the agents are presumed or confirmed to exist. Quarantine of the premises is imposed by State or Federal authorities and all susceptible animals euthanized.

**Infected Zone—**The zone or area immediately around infected and contact premises.

**Movement controls—**A system of permits and record keeping allowing tracing of animals and proper biosecurity to be maintained during a disease outbreak. Examples of practices involving movement controls include maintaining a closed herd or flock, identifying all animals, keeping accurate records, and protecting animals from contact with wildlife.

**Office International des Epizooties—**The intergovernmental organization created by the International Agreement of 25 January 1924, signed by 28 countries. In May 2002, the OIE totaled 162 Member Countries. OIE standards are recognized by the World Trade Organization as reference international sanitary rules. The purpose of the OIE is to guarantee the transparency of animal disease status world-wide.

**Peptonize—**To convert a protein into peptone which is readily soluble in water by the action of an acid or enzyme.

**Photon—**A quantum of electromagnetic radiation.

**Poultry**—Chickens, ducks, geese, swans, turkeys, pigeons, doves, pheasants, grouse, partridges, quail, guinea fowl, and pea fowl (9 CFR 53).

**Glossary**

**Premises—**include a tract of land, and all of its buildings, as well as a separate farm or facility that is maintained by a single set of services and personnel.

**Quarantine Area—**includes the area comprising the Infected Zone and Surveillance Zone.

**Sanitize—**The process of cleaning and sterilizing areas, surfaces or items such as eating or drinking utensils.

**Saponify—**To hydrolyze a fat with alkali to form a soap and glycerol.

**Sentinel animal—**An animal susceptible to a specific disease which is placed on premises where the disease might exist to demonstrate the presence or absence of the disease.

**State—**Any of the States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, the Commonwealth of the Northern Mariana Islands, the Virgin Islands of the United States, or any territory or possession of the United States (Animal Health Protection Act 2002).

**Sterilize—**To render sterile; to free from microorganisms.

**Surveillance Zone—**That area immediately around an infected zone where susceptible animals are being observed for signs of disease.

**Suspect premises—**Premises which appear to have a high likelihood of being related to known infected premises.

**Ultraviolet—**That part of the electromagnetic spectrum that cannot be seen by the human eye extending from approximately 240 nm to 330 nm. The wavelengths from 240 nm to 290 nm which are more harmful to cells are filtered out by the ozone layer in earth's upper atmosphere but may be produced artificially by special gas discharge tubes.

**U.S.P.—**United States Pharmacopeia, a legally recognized compendium of standards for drugs. It contains references for assays and tests to measure quality, purity and strength.

**Vegetative—**Stage when nutrition is being taken up and growth occurs.

**Zoonotic disease—**An infectious disease that is common to humans and animals.

**Appendix I**
**Sample Personnel**
**Orientation Fact sheet**

## Biosecurity: DOs and DON'Ts

Before ENTERING premises,

DO:

- Park your vehicle away from site production facilities and/or ensure that your vehicle's tires and wheel wells have been hosed so they are free of dirt and debris and/or that your vehicle has been taken through a pressure car wash.

- Designate a "clean" area in your vehicle—usually the passenger compartment. Keep it separate from the "dirty" area—usually the trunk or cargo area.

- Put on clean coveralls, boots, hat, gloves, and other apparel and use only clean equipment and supplies.

- Wash your hands with soap and water.

- Consult with the owner to identify an arbitrary line on the site demarcating a "clean" side and a "dirty" side.

DON'T:

- Enter a site's or vehicle's "clean" area unless you have disposed of or cleaned and disinfected all clothes, footwear, hats, gloves, equipment, supplies, and other sources of pathogen transmission.

- Attempt to disinfect a surface unless it first has been thoroughly cleaned.

- Drive your vehicle on premises any more than necessary. An on-site vehicle should be used for on-site transportation whenever possible.

(continued)

**Appendix I**
**Sample Personnel**
**Orientation Fact sheet**

**Biosecurity: DOs and DON'Ts**
(continued)

Before LEAVING premises,

DO:

- Use a brush and approved disinfectant to clean and disinfect all reusable equipment and clothing, including eyewear, thoroughly.
- Hose down vehicle tires and wheel wells so they are free of dirt and debris.
- Place disposable coveralls (turned "inside out"), boots, and other soiled items in a plastic garbage bag to be left with the owner or placed in the "dirty" area of your vehicle.
- Dispose of the disinfectant solution according to label instructions.
- Dispose of all plastic garbage bags containing soiled supplies in a manner that prevents exposure to other people or animals.
- Wash your hands with soap and water.
- Clean and/or launder all reusable clothing and equipment.
- Take a shower and shampoo your hair, clean under your fingernails, and clear your respiratory passages by blowing your nose, clearing your throat, expectorating into a sink with running water, and washing your hands with soap and water.

DON'T:

- Bring "dirty" paperwork into the clean area of your vehicle.
- Visit another susceptible site until 12 hrs have passed.*

**Note:* The minimum waiting period of 12 hrs applies only to official animal health emergency personnel who follow biosecurity procedures on their premises visits. For other premises visitors, the minimum waiting period is 5 days. Additional information is available in the NAHEMS "Cleaning and Disinfection" guidelines (in progress).

**Appendix II**
**Cleaning and Disinfecting Equipment and Supplies**

**For a crew of 10 persons**

INDIVIDUAL EQUIPMENT (Each member draws personal equipment from SUPPLY)

| | | |
|---|---|---|
| Coveralls (cloth) | 1 pair | |
| Coveralls (disposable) | 2 pair | |
| Coat (waterproof) | 1 each | |
| Pants (waterproof) | 1 each | |
| Hat (waterproof) | 1 each | |
| Gloves (heavy gauntlet rubber) | 1 pair | |
| Gloves (surgical rubber) | 5 pair | (for fine work if needed) |
| Masks (surgical) | 3 each | (if needed) |
| Respirator | 1 each | (if needed) |

HAND TOOLS

| | |
|---|---|
| Claw hammer | 2each |
| Pliers | 2 each |
| Screwdriver | 2 each |
| Philips screwdriver | 2 each |
| Crescent wrench (12 inch) | 2each |
| Crowbar | 2 each |
| Hatchet | 2 each |
| Wire brushes (with scraper nose) | 2 Dozen |
| Fiber brushes (long handled) | 5 each boot brushes |
| Pails (12-14 quart) | 6 each |
| Sponges | 2 dozen |
| Tent (or other shelter) | 1 each |
| Axe | 2 each |
| Shovels (flat) | 2 each |
| Fork (manure) | 2 each |
| Brooms (heavy) | 3 each |
| Hoes | 4 each |
| Garden rakes | 2 each |
| Scrapers (long handled) | 2 each ice scrapers or straighten hoes |
| Post-hole digger | 2 each |
| | |
| Hose (3/4 inch x 25 foot) | 3 each |
| Shop vacuum | 1 each |
| Electrical cord (12 ga – 100 ft) | 1 each |

**For a crew of 10 persons**
(continued)

POWER TOOLS & EQUIPMENT

| | |
|---|---|
| Power spray unit and tank | 1 each |
| Spray nozzle | 2 each |
| Safety can (5gal w/gas) | 1 each |
| Hose (3/4 inch x 50 foot) | 5 each |

MISCELLANEOUS

| | |
|---|---|
| Rubber gloves | 10 pair extra supply in reserve |
| Safety goggles | 4 each extra supply in reserve |
| Plastic Tub (10 gallon) | 2 each |
| Metal cans (10 gallon) | 2 each |
| Garbage can (galvanized – 30 gal) | 2 each |
| Plastic Bag (8mil – 50 gallon) | 100 each for debris |
| Plastic Bag (4mil – 30 gallon) | 50 each for clothes & miscellaneous |
| First Aid Kit with EYE WASH | 1 each |
| Bottled Water | 1 gal/person (in pint or quart portions) |
| Sports Drink | 1 qt/person (in individual portions) |

CHEMICALS

Vinegar (If using NaOH) 1 gallon SAFETY ITEM
Detergent (liquid) 1 gallon
Soda Ash (Sec. 18) 100 lbs for 300 gallons working solution
(Anhydrous sodium carbonate [$Na_2CO_3$]) 4%w/v = 1lb/3gallons water
Lye (Sec. 18) 50 lbs for 300 gallons working solution
(Sodium hydroxide [NaOH]) 2%w/v = 1lb/6gallons water
Other suitable commercial brands are available – consult Chemical Disinfectants on page 18. Choose a disinfectant with EPA approval for the disease agent and use it according to the label directions.

## Appendix III
## USDA Statutory Authorities

21 U.S.C. 111 authorizes the Secretary to take measures to prevent introduction or dissemination of the contagion of any contagious, infectious, or communicable disease of animals and poultry moving interstate or into the US.

21 U.S.C. 114 authorizes the Secretary to prepare rules and regulations for speedy and effectual suppression and extirpation of dangerous, contagious, infectious, and communicable diseases and to invite State authorities to participate in their execution and enforcement.

21 U.S.C. 114a authorizes the Secretary to cooperate with States or political subdivisions, farmers associations, and individuals to control and eradicate any communicable disease of livestock or poultry, incipient or potentially serious minor outbreaks of disease in domestic animals, and contagious or infectious diseases of animals (FMD specified) which in the opinion of the Secretary constitute an emergency and threaten the livestock industry of the country, excluding the payment of loses growing out of destruction of animals and materials affected by or exposed to any such disease.

21 U.S.C. 134a (a) authorizes the Secretary to seize, quarantine and dispose of:

- Animals that are moving, have moved, or are being handled in interstate or foreign commerce contrary to any law or regulation of the Department for control of livestock and poultry diseases.
- Animals moving into the U. S. or interstate, which are affected with or exposed to a communicable disease of livestock or poultry.
- Any animals which have moved into the US or interstate and at the time of such movement were exposed to a communicable disease of livestock or poultry.

21 U.S.C. 134a(b) authorizes the Secretary to declare an Extraordinary Emergency when any dangerous, communicable disease of livestock or poultry, such as FMD, exists on any premises in the U. S. and adequate measures are not being taken by the State or other jurisdiction to prevent its dissemination.

Under an Extraordinary Emergency the Secretary may seize, quarantine, and dispose of any animals, which are or have been affected with or exposed to the disease and the carcasses of any such animals and any products and articles which she finds were so related to such animals as to be likely to disseminate any such disease.

21 U.S.C. 134(c) authorizes the Secretary to order the quarantine or disposal of animals, carcasses, products, or articles subject to 134a(a) and (b), and if, the owner fails to comply with the order, the Secretary can dispose of the animals and articles and recover the costs of disposal from the owner.

21 U.S.C. 134(d) requires the Secretary to pay fair market value for animals, articles and materials destroyed by the Department

**Appendix IV**
**USDA Regulations**

APHIS FMD and other exotic diseases compensation regulations at 9 C.F.R. Part 53 (under revision)

9 C.F.R. 53.2(b) – stipulates that if a State agrees to enforce quarantine restrictions and orders and directives in the control and eradication of FMD:

APHIS will pay 50% of the expenses of purchase, destruction and disposition of destroyed animals or material;

APHIS will pay 100% of purchase, destruction, and disposition if animals are exposed to disease prior to or during interstate movement and are not eligible to receive indemnity from any State.

**Appendix V**

## Disinfectants Approved under FIFRA Section 18 for Use Against OIE List A Foreign Animal Diseases

| Foreign Animal Disease | Disinfectant(s) approved for APHIS Use Only | Disinfectants Approved for Use by State Officials and the General Public |
|---|---|---|
| **African horse sickness** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **African swine fever** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Bluetongue** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Classical swine fever** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Contagious bovine pleuropneumonia** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Foot and Mouth Disease** | Sodium Carbonate (4%) | Sodium Hypochlorite (up to 12.5%) |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | Acetic Acid (4-5%) |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Highly pathogenic avian influenza** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |

| | | |
|---|---|---|
| **Lumpy skin disease** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Newcastle disease** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Peste des petits ruminants** | NONE | |
| **Rift Valley fever** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Rinderpest** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Sheep pox and goat pox** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Swine vesicular disease** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |
| **Vesicular stomatitis** | Sodium Carbonate (4%) | |
| | Sodium Carbonate (4%) and Sodium Silicate (0.1%) | |
| | Sodium Hydroxide (2%) | |
| | Sodium Hypochlorite (up to 12.5%) | |