



HAZARDOUS MATERIALS MANAGEMENT PROGRAM

Section 2. Biological Safety

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1.0 **PURPOSE**

The purpose of this section is to specify the practices, procedures and requirements for safe handling and use of biohazardous materials for research, and teaching activities at USC.

2.0 **DEFINITIONS**

Aerosols are defined as clouds of very small liquid droplets produced whenever energy is applied to a liquid, and such liquid is allowed to escape into the environment.

Biohazardous materials and organisms are: all infectious agents (bacteria, chlamydia, fungi, parasites, prions, rickettsias, viruses, etc.) which can cause disease in humans, or cause significant environmental or agricultural impact; human or primate tissues, fluids, cells or cell culture; recombinant DNA; transgenic plants or animals; and zoonotic diseases.

Bloodborne pathogens (BBP) are pathogenic microorganisms that are present in human "blood" and "other potentially infectious material." These pathogens include hepatitis B virus (HBV), Hepatitis C (HCV) and human immunodeficiency virus (HIV), syphilis, malaria and many others.

Blood means human blood, human blood components and products made from human blood.

BSC means biological safety cabinet.

Fomite means the infectious agents in the droplets remain in a dried state as "droplet nuclei".

Other Potentially Infectious Materials means:

- The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any other body fluid that is visibly contaminated with blood and all undifferentiated body fluids in emergency response situations;
- Any unfixated tissue or organ (other than intact skin) from a human;
- Established human or non-human primate cell lines;
- HIV-containing cell or tissue cultures, organ cultures and HIV, HBV, or HCV-containing culture medium or other solutions; and blood, organs or other tissues from experimental animals infected with HIV, HBV, or HCV.

Transgenic organism is an organism whose genome has been altered by the transfer of a gene or genes from another species or breed.

Universal Precautions is an approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids/tissues/cell lines are treated as if known to be infectious for HIV, HBV, HCV and other blood-borne pathogens.

<http://www.dir.ca.gov/title8/5193.html>

3.0 BIOLOGICAL SAFETY LEVELS

Table 1 summarizes biosafety levels in terms of practices, facilities, containment equipment, and PPE. The laboratory director is responsible for ensuring laboratory personnel use appropriate work practices, containment equipment, protective equipment, and all other preventive measures.

4.0 LABORATORY EQUIPMENT

Various laboratory procedures generate aerosols that may spread biohazardous material in the work area and may pose a risk of infection to the worker. Biological safety cabinets (BSC) are used to prevent the escape of aerosols or droplets and to protect the research product from airborne contamination.

These devices are distinct from horizontal or vertical laminar flow "clean benches," which should never be used for handling biohazardous, toxic or sensitizing material.

4.1 Biological Safety Cabinets

The three major classes of biosafety cabinets are:

- **Class I** biological safety cabinets are enclosures similar to chemical fume hoods, with an inward airflow through the front opening. The exhaust air from the biological safety cabinet is passed through a HEPA filter so that the equipment provides protection for the worker and the public. The product (research material) in the cabinet, however, is subject to contamination. **The use of Class I cabinets is discouraged at USC. Contact Laboratory Safety prior to using a Class I BSC.**
- **Class II** biological safety cabinets are designed to protect the worker, the general public and the product. The airflow velocity at the face of the work opening is at least 75 linear feet per minute (lfpm). Both the supply and the exhaust air are HEPA-filtered.
- **Class III** biosafety cabinet--each differentiated in accordance with the parameters shown in the chart below.

Class I and Class II cabinets are partial containment devices which, if used in conjunction with good laboratory practices, can dramatically reduce the risk of operator exposure to biohazardous material aerosols and droplets.

Go to <http://www.cdc.gov/od/ohs/biosfty/bmbl4/b4aa.htm> for more information on biosafety cabinets.

4.1.1 Proper Use

Follow the procedures below to start up the BSC:

- Turn off ultraviolet sterilizer (if so equipped) upon entering the room;
- Turn on all blowers and cabinet illumination lights;
- Allow five minutes of operation to purge system; check flow alarm system audio and visual alarm function if so equipped; and
- Decontaminate readily accessible interior surfaces with a disinfectant appropriate for the agents or suspected agents present.

Follow the procedures below to shut down the BSC:

- Decontaminate and remove all items from interior work area;
- Decontaminate readily accessible interior surfaces with a disinfectant appropriate for the agents or suspected agents present;
- Turn on ultraviolet sterilizer if so equipped;
- Allow five minutes of operation to purge system; and
- Turn off cabinet blower.

4.1.2 Moving/Installation

Biosafety cabinet work surfaces must be decontaminated by an approved biosafety cabinet contractor prior to moving to new facilities. Each biological safety cabinet must be recertified for correct air flow and filter integrity after it has been moved and placed in its final location. See Certification below.

4.1.3 Decontamination

Decontamination is performed by certified professionals. The BSC must be decontaminated prior to filter change, maintenance, or relocation.

4.1.4 Certification

It is the PI's responsibility to ensure that all biological safety cabinets used for handling biohazardous materials are **recertified annually**. Contact the following NSF-approved vendors for certification.

Technical Safety Services, Inc.
1-800-877-7742
www.techsafety.com

ENV Services
1-800-486-3368

4.2 Chemical Fume Hood vs. Biological Safety Cabinet

It is important to know the difference between a biosafety cabinet and a chemical fume hood. Biosafety cabinets are designed to protect the individual and the environment from biological agents, and to protect the research materials from contamination. Chemical fume hoods, however, are designed solely to protect the individual from exposure to hazardous chemicals and noxious gases. Since chemical fume hoods are not equipped with HEPA filters, they must not be used for work with biohazardous materials.

4.3 Centrifuges

- Hazards associated with centrifuging include mechanical failure (e.g., rotor failure, tube or bucket failure) and the creation of aerosols. To minimize the risk of mechanical failure, centrifuges must be maintained and used according to the manufacturer's instructions; users must be properly trained: and operating instructions that include safety precautions must be prominently posted on the unit.
- Aerosols are created by practices such as filling centrifuge tubes, removing plugs or caps from tubes after centrifugation, removing supernatant, resuspending sedimented pellets and by the very process of centrifugation. The greatest aerosol hazard is created if a tube breaks during centrifugation. To minimize the generation of aerosols when centrifuging biohazardous material, the following procedures should be followed:

Table 1. USC Laboratory Containment Levels for Biological Research Involving Potential Biohazards

BIOSAFETY LEVELS (BSL)	BSL-1	BSL-2	BSL-3 Practice in BSL-2 Facilities	BSL-3
A. HAZARD LEVELS				
<i>Degree of hazard</i>	Low Risk: E:coli K-12	Low to Moderate; Influenza viruses, Mycobacterium sp., Herpes viruses	Moderate to High: specific experiments w/BSL-3 agents which the IBC authorizes in BSL-2 facilities	High (serious or potentially lethal consequences): M. tuberculosis, HTLV, HIV, Brucella sp.
B. STANDARD MICROBIOLOGICAL PRACTICES				
1. Public access while experiments are in process	Not recommended	Access to the lab is limited when BSL-2 work is being conducted	Restricted	Not permitted
2. Daily contamination	Daily & upon spills	Daily & upon spills	Daily, upon finished work with biohazardous materials & spills	Daily, upon finished work & spills
3. Biohazardous waste decontamination	Via an approved offsite medical waste vendor	Via an approved medical waste hauler	Via an approved offsite medical waste vendor	Before removal from building and via an approved offsite medical waste vendor
4. Pipetting	Mechanical device	Mechanical device	Mechanical device	Mechanical device
5. Eating, drinking, application of cosmetics or contact lenses	Permitted only in designated clean areas	Permitted only in designated clean areas	Not permitted at any time	Not permitted at any time
6. Handwashing facilities	Required	Required	Required (foot/elbow/electronic operation recommended)	Required (foot/elbow/electronic operation)
7. Aerosol minimization	Required	Required	Required	Required

BIOSAFETY LEVELS (BSL)	BSL-1	BSL-2	BSL-3 Practice in BSL-2 Facilities	BSL-3
8. Laboratory coats	Recommended (front button coats)	Required (front button coats)	Wrap around disposable clothing required for all workers with potential exposure to biohazardous materials	Required (wrap around disposable clothing)
C. SPECIAL PRACTICES				
1. Autoclave	Not Required	Must be available	Must be available (See note 1)	Required, preferably in laboratory
2. Insect/rodent control program	Required	Required	Required	Required
D. CONTAINMENT EQUIPMENT				
1. Biological Safety Cabinet (BSC)	Not required	Required for all aerosol generating processes	Required for all work with biohazardous agents	Required for all work
2. Other physical containment	Equipment must be decontaminated immediately after use	Physical containment devices are used when procedures with a high potential for creating aerosols are being conducted with biohazardous materials (See note 2). If high concs/large volumes of biohazardous materials are used, some types of material may be centrifuged in the open laboratory if sealed heads or centrifuge safety cups are used, and if the containers are opened only in a biological safety cabinet. Equipment must be decontaminated immediately after use.	Physical containment devices, such as <i>centrifuge safety cups, sealed centrifuge rotors and containment caging for animals</i> are used for all activities with biohazardous materials that pose a threat of aerosol exposure. (See note 3) Equipment must be decontaminated immediately after use.	Physical containment devices, such as <i>centrifuge safety cups, sealed centrifuge rotors and containment caging for animals</i> are used for all activities with biohazardous materials that pose a threat of aerosol exposure. (See note 3) Equipment must be decontaminated immediately after use.

BIOSAFETY LEVELS (BSL)	BSL-1	BSL-2	BSL-3 Practice in BSL-2 Facilities	BSL-3
3. Freezers/ refrigerators	No biohazard sign required	Biohazard sign must be posted	Biohazard sign must be posted and containers must be labeled	Biohazard sign must be posted and containers must be labeled
4. BSC Certification	Certified every 3 years	Certified annually	Certified annually	Certified annually
5. HEPA-filtered vacuum lines	Required	Required	Required	Required
6. BSC work surface decontamination	Daily & following spills	Required after each use	Required	Required
7. Personal Protective Equipment (PPE) when working within primary containment (e.g., BSC)	Required - gloves should be worn when handling infected animals and when skin contact with hazardous materials is unavoidable	Required - appropriate combinations of special protective clothing, gloves, etc., are used for all activities with biohazardous materials. (See note 4)	Required - appropriate combinations of special protective clothing, gloves, etc., are used for all activities with biohazardous materials. (See note 4)	Required - appropriate combinations of special protective clothing <i>plus NIOSH N95 respirators or better must be worn in rooms containing infected animals.</i>
8. Personal Protective Equipment (PPE) when working outside of primary containment	Required - gloves must be worn when handling infected animals and when skin contact with biohazardous materials is unavoidable	Required - appropriate combinations of special protective clothing <i>plus a minimum of NIOSH N95 respirators or better must be worn in rooms containing infected animals or as directed by the IBC.</i>	Required - appropriate combinations of special protective clothing <i>plus NIOSH N95 respirators or better must be worn in rooms containing infected animals. Additional PPE may be required based on IBC review.</i>	Required - appropriate combinations of special protective clothing <i>plus NIOSH N95 respirators or better must be worn in rooms containing infected animals.</i>

Note 2: These procedures include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, opening containers of biohazardous materials whose internal pressures may be different from ambient pressures, inoculating animals intranasally, and harvesting infected tissues from animals or eggs.

BIOSAFETY LEVELS (BSL)	BSL-1	BSL-2	BSL-3 Practice in BSL-2 Facilities	BSL-3
<p><i>Note 3: These procedures include manipulation of cultures and of clinical or environmental material that may be a source of aerosols containing biohazardous materials; the aerosol challenge of experimental animals; harvesting of tissues from infected animals and embryonic eggs; and necropsies of infected animals.</i></p>				
<p><i>Note 4: Required with aerosol generating equipment; manipulation of high concentrations or large volumes of biohazardous materials; activity involving all clinical specimens; body fluids and tissues from humans or from infected animals or eggs; human cell culture; necropsies of infected animals.</i></p>				
<p>E. LABORATORY FACILITIES</p>				
1. Ventilation	Negative pressure; no recirculation of air to other areas of the building	Negative pressure; no recirculation of air to other areas of the building	Air flows from low hazard to higher hazard areas; no recirculation of air is permitted	Negative pressure; no recirculation of air to other areas of the building.
2. Posted biohazardous material/biosafety level signs	Not required	Required on lab doors in areas where BSL-2 materials are stored and where work is done	Required on lab doors in areas where BSL-3 materials are stored and where work is done	Required on lab doors in areas where BSL-3 materials are stored and where work is done
3. Bench top work	Permitted	Permitted only for procedures with a low-risk of splash, splatter or aerosol production	Not permitted for biohazardous materials	Not permitted
4. Operable windows	Permitted with fly screens	Permitted with fly screens	Not permitted	Not permitted
5. Laboratory separated from the general public	No	No	Yes. Doors must be closed and locked when work is being done with biohazardous materials	Yes. Doors must be closed at all times.

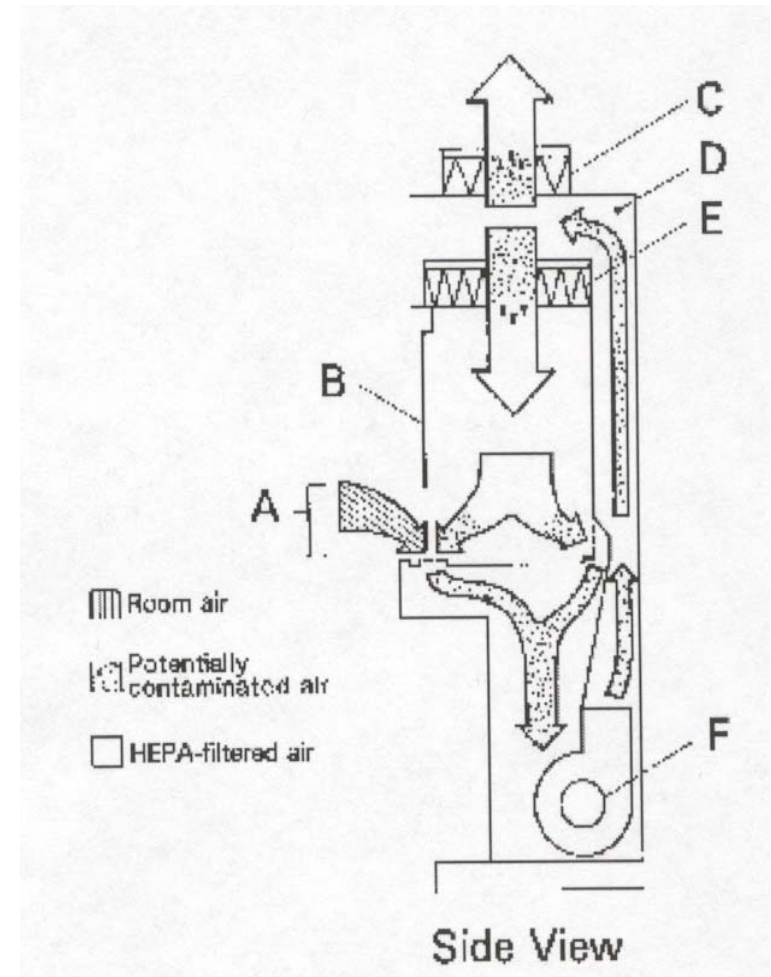
BIOSAFETY LEVELS (BSL)	BSL-1	BSL-2	BSL-3 Practice in BSL-2 Facilities	BSL-3
F. OTHER REQUIREMENTS				
1. Technical Training	Required with documentation	Annual training with documentation required	Annual training with documentation required	Safety issues should be covered as a part of monthly training (e.g. lab meetings) with documentation required
2. Medical Surveillance (baseline serology)	Required when appropriate	Required when appropriate	Required when appropriate	Required
3. Spill/accidents	Report immediately to lab director; medical evaluation, surveillance and treatment are provided as appropriate; maintain written records	Report immediately to lab director; medical evaluation, surveillance and treatment are provided as appropriate; maintain written records	Report immediately to lab director; medical evaluation, surveillance and treatment are provided as appropriate; maintain written records	Report immediately to lab director; medical evaluation, surveillance and treatment are provided as appropriate; maintain written records
4. Biosafety manual	Personnel must have access to Biosafety Manual; personnel required to be familiar with policies & procedures	Personnel must have access to Biosafety Manual; personnel required to be familiar with policies & procedures	Personnel must have access to Biosafety Manual; personnel required to be familiar with policies & procedures BSL-3 Manual prepared or adopted; personnel required to be familiar with policies & procedures	Personnel must have access to Biosafety Manual; personnel required to be familiar with policies & procedures BSL-3 Manual prepared or adopted; personnel required to be familiar with policies & procedures

Table 2.

Type	Face velocity (lfpm)	Airflow Pattern	Radionuclides/ Toxic Chemicals	Biosafety Level(s)	Product Protection
Class I* open front	75	In at front; rear and top through HEPA filter	No	2,3	No
Class II Type A	75	70% recirculated through HEPA; exhaust through HEPA	No	2,3	Yes
Type B1	100	30% recirculated through HEPA; exhaust via HEPA and hard ducted	Yes (Low levels/volatility)	2,3	Yes
Type B2	100	No recirculation; total exhaust via HEPA and hard ducted	Yes	2,3	Yes
Type B3	100	Same as IIA, but plena under negative pressure to room and exhaust air is ducted	Yes	2,3	Yes
Class III	NA	Supply air inlets and exhaust through 2 HEPA filters	Yes	3,4	Yes

* Glove panels may be added and will increase face velocity to 150 lfpm; gloves may be added with an inlet air pressure release that will allow work with chemicals/radionuclides.

Figure 1.



4.3 *Centrifuges* continued

- Use sealed tubes and safety buckets that seal with O-rings. Before use, inspect tubes, O-rings and buckets for cracks, chips, erosions, bits of broken glass, etc. Do not use aluminum foil to cap centrifuge tubes because it may detach or rupture during centrifugation;
 - Fill and open centrifuge tubes, rotors and accessories in a biosafety cabinet (BSC). Avoid overfilling of centrifuge tubes so that closures do not become wet. After tubes are filled and sealed, wipe them down with disinfectant;
 - Add disinfectant to the space between the tube and the bucket to disinfect material in the event of breakage during centrifugation;
 - Always balance buckets, tubes and rotors properly before centrifugation;
 - If the centrifuged specimen contains biohazardous material, open the centrifuge tubes inside a BSC with the tube pointed away from you;
 - Do not decant or pour off supernatant. Use a vacuum system with appropriate in-line reservoirs and filters. (For more information, call Laboratory Safety (323) 442-2200); and
 - Work in a BSC when resuspending sedimented material. Use a swirling rotary motion rather than shaking. If shaking is necessary, wait a few minutes to permit the aerosol to settle before opening the tube.
- Small low-speed centrifuges may be placed in a BSC during use to reduce the aerosol escape. High-speed centrifuges pose additional hazards;
 - Precautions should be taken to filter the exhaust air from vacuum lines;
 - Manufacturers' recommendations must be meticulously followed to avoid metal fatigue, distortion and corrosion; and
 - Avoid the use of celluloid (cellulose nitrate) tubes with biohazardous materials. Celluloid centrifuge tubes are highly flammable and prone to shrinkage with age. They distort on boiling and can be highly explosive in an autoclave. If celluloid tubes must be used, an appropriate chemical disinfectant must be used to decontaminate them.

4.4 *Aerosol-creating Equipment*

The use of blenders, ultrasonic disrupters, grinders and lyophilizers can result in considerable aerosol production. This equipment should be used in a BSC when working with biohazardous materials.

- Safety Blenders. These are designed to: prevent leakage from the bottom of the blender jar; provide a cooling jacket to avoid biological inactivation; and, withstand sterilization by autoclaving. If blender rotors are not leak proof, they should be tested with sterile saline or dye solution prior to use with biohazardous material. The use of glass blender jars is not recommended because of the breakage potential. If they must be used, glass jars should be covered with a polypropylene shroud to prevent spraying of glass and contents in the event the blender jar breaks. A towel moistened with disinfectant should be placed over the top of the blender during use. Before opening the blender jar, allow the unit to rest for at least one minute to allow the aerosol to settle and then open in a BSC. The device should be decontaminated promptly after use.
- Lyophilizers and Ampoules. Depending on lyophilizer design, aerosol production may occur when material is loaded or removed from the lyophilizer unit. If possible, sample material should be loaded in a BSC. The vacuum pump exhaust should be filtered to remove any hazardous agents or, alternatively, the pump can be vented into a BSC. After lyophilization is completed, all surfaces of the unit that have been exposed to the agent should be disinfected. If the lyophilizer is equipped with

a removable chamber, it should be closed off and moved to a BSC for unloading and decontamination. Handling of cultures should be minimized and vapor traps should be used wherever possible.

- Opening ampoules containing liquid or lyophilized culture material should be performed in a BSC to control the aerosol produced. Gloves must be worn. To open, nick the neck of the ampoule with a file. Wrap it in a disinfectant soaked towel. Hold the ampoule upright and snap it open at the nick. Reconstitute the contents of the ampoule by slowly adding liquid to avoid aerosolization of the dried material. Mix the contents without bubbling and withdraw it into a fresh container. Discard the towel and ampoule top and bottom as biohazardous material waste; and
- Ampoules stored in liquid nitrogen may explode after removal potentially causing injuries. The use of polypropylene tubes and tongs will mitigate this hazard. These tubes are available dust-free and pre-sterilized, and are fitted with polyethylene caps with silicone washers. Heat sealable polypropylene tubes are also available.

5.0 DISINFECTANTS

All equipment and work surfaces contaminated with biological material should be decontaminated with an appropriate disinfectant upon completion of procedures and/or at the end of the work shift.

The ideal disinfectant (a) kills or inactivates a biological agent and is rapid in action, (b) is non-corrosive, nonflammable, and nondestructive to materials, and (c) is inexpensive, easily removed from surfaces, and has low toxicity to humans and animals. Suitable disinfectants are listed in Table 3.

Factors that could influence its effectiveness are (a) presence of organic material, (b) concentration of the chemical, (c) properties of the biological agent, (d) action of the chemical being specific to the agent, and (e) contact time. Higher concentrations and longer contact times as directed in Table 3 should be considered to counter these factors.

Disposal of disinfectants (except for bleach and ethanol) must be treated as chemical waste in accordance with provisions established in Section 5 Hazardous Waste Management. Bleach and ethanol may be disposed of down the drain.

6.0 BLOODBORNE PATHOGENS, HUMAN TISSUE, AND CELL CULTURE

6.0.1 Exposure Control Plan

If there is any possibility an employee may be exposed to BBP's during the course of their work, the Principal Investigator must do the following:

- Implement a written Exposure Control Plan which adopts BSL-2 or higher containment practices and procedures;
- Perform and document the following:
 - Exposure determination;
 - Procedure for the evaluation of exposure incidents;
 - Hepatitis B vaccination and follow up;
 - Training; and
 - Record keeping.

Table 3.

Use Parameters	Ethylene Oxide	Paraformaldehyde (gas)	Quaternary Ammonium compounds	Phenolic compds	Chlorine compds	Iodophore compds	Alcohol (ethyl or isopropyl)	Formaldehyde	Glutaraldehyde
Concentration of active ingredients	400-800 mg/L	0.3 g/cu.ft.	0.1 - 2%	0.2 - 3%	0.01 - 5%	0.47%	70 - 85%	4 - 8%	2%
Temp. (°C)	35 - 60	> 23							
Relative humidity (%)	30 - 60	> 60							
Contact time (minutes)	105 - 240	60 - 180	10 - 30	10 - 30	10 - 30	10 - 30	10 - 30	10 - 30	10 - 600
Effective Against									
Vegetative Bacteria	+	+	+	+	+	+	+	+	+
Bacterial spores	+	+			±			±	+
Lipo viruses	+	+	+	+	+	+	+	+	+
Hydrophilic viruses	+	+		±	+	±	±	+	+
Tubercle bacilli	+	+		+	+	+		+	+
HIV	+	+	+	+	+	+	+	+	+
HBV	+	+		±	+	±	±	+	+
Applications									
Contaminated liquid discard					+			±	
Contaminated glassware	±		+	+	+		+	±	+
Contaminated instruments	±			+				±	+
Equipment total decontamination	±	+							
+ denotes a very positive response. ± denotes a less positive response. blank denotes a negative response or not applicable									

6.0.2 Methods of Compliance

USC observes the concept of Universal Precautions. Follow BSL-2 practices and procedures for all teaching, clinical, research or other work with human blood, tissues, cells and fluids.

All laboratory coats and contaminated items should be decontaminated (i.e., steam autoclaved) prior to cleaning and laundry.

6.0.3 Engineering & Work Practice Controls

The term "Engineering Controls" refers to controls (e.g., sharps disposal containers, needle-less systems and self-sheathing needles) that isolate or remove the hazard of blood-borne pathogens from the workplace and, therefore, reduce the potential for employee exposure. Other devices include biosafety cabinets and uni-directional airflow from areas of lower to areas of higher hazards.

Work practice controls include frequent handwashing; proper handling and disposal of contaminated needles; no eating, drinking, smoking, application of cosmetics or contact lenses in the lab; and no mouth pipetting.

Food and drink must neither be stored in the same refrigerator, nor on the same shelves, countertops or benchtops where BBP's are placed. Containers used for storage, transport or shipping of blood-borne pathogens must be labeled properly

6.0.4 Engineered Sharps Injury Protection

Sharps with engineering controls must be used for withdrawing body fluids, accessing a vein or artery, or administering medications or other fluids, which effectively reduces the risk of an exposure incident by a mechanism such as barrier creation, blunting, encapsulation, withdrawal or other effective mechanisms or a physical attribute built into any other type of needle device, or into a non-needle sharp.

CAL/OSHA Needleless Systems and Needles with Engineered Sharps Injury Protection List

<http://www.dhs.cahwnet.gov/ohb/SHARPS/disclaim.htm>

6.0.5 Personal Protective Equipment (PPE)

In addition to engineering controls, personal protective equipment must also be used. It is essential for each employee who has the potential of coming into contact with Bloodborne Pathogens (BBP) or Other Potentially Infectious Material (OPIM) to utilize the appropriate PPE. Minimum PPE requirements include gloves, lab coats or gowns, eye protection, face shields or masks, and closed toe shoes at all times when handling BBP or OPIM.

6.0.6 Housekeeping

A generally clean and sanitary laboratory environment must be maintained. There must be a regular and proper decontamination of all work surfaces, equipment, bins, cans and other similar receptacles intended for reuse. Regulated waste must be separated into contaminated sharps and other wastes, then stored and disposed of in proper containers.

6.1 *HIV, HBV or HCV Research Laboratories*

Unless otherwise permitted by the IBC, laboratories working specifically with HIV, HBV or HCV must follow standard BSL-2 for handling clinical material, and BSL-3 practices and procedures for growing and concentrating virus particles.

6.1.1 *HBV Vaccination and Post-exposure*

The university must make the hepatitis B vaccination available to those employees who have the potential for occupational exposure. Post-exposure evaluation and follow up must be provided to those employees who have had an exposure incident. This must be done at no cost to the employees and at a reasonable time and place. It must be done by or under the supervision of a licensed physician, or by or under the supervision of another licensed health care professional. See 9.0 Medical Surveillance.

6.2 *Working with Human Tissues*

All human blood, blood products, body fluids and tissues are listed as potentially infectious materials. Established human cell lines must be treated as if they are potentially infected with bloodborne pathogens and laboratories working with these materials must have annual Bloodborne Pathogens training.

- **Under no circumstance shall anyone work with cells derived from themselves or from first-degree relatives since the host immune systems may not provide adequate protection;**
- Biosafety Level 2 practices and procedures must be followed when handling human blood, blood products, body fluids and tissues because of the infectious agents they may contain, including established human cell lines. Biosafety Level 2 practices and procedures are consistent with the concept known as "Universal Precautions" which requires all specimens of human blood, blood products, body fluids and tissues to be treated as if they are infectious;
- Investigators using human blood, blood products, body fluids or tissues must complete a laboratory-specific Exposure Control Plan. The completed plan must be readily available in the laboratory for all workers;
- Laboratory personnel (faculty and staff) in HIV, HCV or HBV research laboratories must fulfill additional requirements as follows:
 - The employee must attend an annual general biosafety training offered by EH&S;
 - The employee must have prior experience in the handling of human pathogens or tissue cultures before working with HIV, HCV or HBV; and
 - Before being allowed to work with HIV, HCV or HBV, the employee must demonstrate proficiency in standard microbiological practices and techniques and in the practices and operations specific to the laboratory to the satisfaction of the Principal Investigator/laboratory supervisor;
- An employee with no prior experience in handling human pathogens must be trained in the laboratory prior to handling infectious materials. Initial work activities shall not include handling of infectious agents. A progression of work activities will be assigned as techniques are learned and proficiency is developed. Participation in work activities involving infectious agents will be allowed only after proficiency has been demonstrated to the satisfaction of the Principal Investigator/laboratory supervisor.

6.3 Cell Culture

When cell cultures are known to contain an etiologic agent, an oncogenic virus or amphotropic packaging system the cell line must be classified at the same level as that recommended for the agent.

Furthermore, the following must be handled at Biosafety Level 2 or higher containment level:

- All cell lines of human/primate origin;
- Any cell lines derived from lymphoid or tumor tissue;
- All cell lines exposed to or transformed by any oncogenic virus;
- All cell lines exposed to or transformed by amphotropic packaging systems;
- All clinical material (e.g., samples of human tissues and fluids obtained after surgical resection or autopsy);
- All cell lines new to the laboratory (until proven to be free of all adventitious agents); and
- All mycoplasma-containing cell lines.

7.0 INFECTIOUS AGENTS, RECOMBINANT DNA, AND CDC SELECT AGENTS

7.1 Infectious Agents

Research or teaching activities involving infectious agents require prior approval by the Institutional Biosafety Committee. Researchers and students must follow requirements as specified in the [CDC/NIH Biosafety in Microbiological and Biomedical Laboratories Manual](#).

7.1.1 Modes of Infection

Microorganisms can enter the body through mucous membranes, respiratory tract, broken or intact skin and the conjunctivae. It should be noted that in laboratory-acquired infections, the route may not be the same as when the disease is acquired naturally.

Modes of infection are:

- **Injection** such as pricking, jabbing, or cutting the skin with contaminated instruments such as hypodermic needles, scalpels and glassware, and from animal bites or scratches.
- **Ingestion** resulting from mouth-pipetting, eating, drinking and smoking.
- **Absorption** through the skin from splashing into the face and eyes, spillage, and direct contact.
- **Inhalation** of aerosols, droplets and fomites. It has been shown that many laboratory techniques using both simple and complex mechanical equipment, as well as laboratory accidents, produce aerosols. These include: use of microbiology loops, pipettes, syringes and needles, opening tubes and bottles, use of centrifuges and blenders, harvesting of eggs and other virological procedures, lyophilization, and breakage of cultures.

The PI and laboratory staff must bear in mind that a large number of organisms that would ordinarily be innocuous can be infectious to immuno-compromised persons. Therefore, more stringent measures must be established by the PI in an effort to prevent the occurrence of lab-acquired infections in such individuals.

7.1.2 Storage of Infectious Materials

Infectious materials must be clearly identified and stored in such a manner as to preclude accidental exposure. This normally includes double containment and labeling of equipment.

7.2 Recombinant DNA, Gene Therapy, and Transgenics

7.2.1 Recombinant DNA

Experiments involving the generation of recombinant DNA (rDNA) normally require registration and approval by the IBC. [Guidelines for Research Involving Recombinant DNA Molecules](#) (April 1998) published by the National Institutes of Health (NIH), is the definitive reference for rDNA research in the United States and has been adopted by USC. If the experimental protocol is not covered by the guidelines, contact Laboratory Safety (323) 442-2200 for determination of further review. USC labs using recombinant DNA must submit a [form](#) for IBC approval prior to initiation of research.

7.2.2 Human Gene Therapy

All protocols involving the use of rDNA for human gene therapy must be approved by the IBC prior to submission to outside agencies and the initiation of experimentation. Prior approval by the Institutional Review Board is required before commencing gene therapy in humans. For more details about IBC approval of human gene therapy protocols, call the Biological Safety Officer (323) 442-2208.

7.2.3 Transgenic Animals, Transgenic Plants, Exotic Plants, or Pests

- Investigators who create transgenic animals must complete an IBC form and submit it to Laboratory Safety for IBC approval prior to initiation of experimentation. In addition, the Institutional Animal Care and Use Committee (IACUC) requires that these protocols be approved by Laboratory Safety prior to full approval by the IACUC.
- Experiments to genetically engineer plants by recombinant DNA methods may require registration with the IBC. To prevent release of transgenic plant materials to the environment, the NIH rDNA guidelines provide specific plant biosafety containment recommendations for experiments involving the creation and/or use of genetically engineered plants. Use of transgenic or exotic plants or pests may necessitate additional training, containment, and security requirements.

7.3 CDC Select Agent and USDA High Consequence Livestock Pathogens

The **Select Agent Rule**, also known as “The Anti-Terrorism and Effective Death Penalty Act of 1996”, initially tracked the transfer of Select Agents including certain Bacteria, Viruses, Fungi, and Biological Toxins due to the potential use as bioterrorist weapons.

The **PATRIOT Act of 2001** requires personnel with access to Select Agents or High Consequence Livestock Pathogens to have a background check performed by the Department of Justice prior to performing research with registered Select Agents.

In December 2002, the Select Agent Rule was modified as a part of **the Public Health and Security and Bioterrorism Preparedness and Response Act of 2002**, to include possession and use of Select Agents and the list was expanded to incorporate the US Department of Agriculture (USDA) High Consequence Livestock Pathogens.

List of CDC Select Agents and USDA High Consequence Livestock Pathogens

VIRUSES

African Horse Sickness virus	Crimean-Congo Haemorrhagic Fever virus	Akabane Virus
African Swine fever	Eastern Equine Encephalitis virus	Camel Pox virus
Avian Influenza virus	Equine Morbillivirus (Hendra virus)/Nipah virus	Ebola virus
Blue Tongue virus	Foot and Mouth Disease virus	Goat Pox virus
Classical Swine fever	Japanese Encephalitis virus	Lassa Fever virus
Malignant Catarrhal Fever	Lumpy Skin Disease virus	Menangle virus
Newcastle Disease virus	South American Haemorrhagic Fever viruses	Marburg virus
Peste des Petits Ruminants	Tick-borne Encephalitis Complex virus	Rinderpest virus
Rift Valley Fever virus	Variola Major virus (Smallpox)	Sheep Pox
Swine Vesicular Disease virus	Venezuelan Equine Encephalitis virus	Yellow Fever virus
Vesicular Stomatitis virus	Viruses causing Hantavirus Pulmonary Syndrome	

BACTERIA

Bacillus anthracis	Brucella abortus	Clostridium botulinum
Brucella suis	Burkholderia (pseudomonas) mallei	Francisella tularensis
Brucella melitensis	Burkholderia (pseudomonas) pseudomallei	Mycoplasma capricolum/M.F.38/
M. Mycoides capri (contagious caprine pleuropneumonia agent)		
Mycoplasma mycoides mycoides (contagious bovine pleuropneumonia agent)		
Yersinia pestis		

RICKETTSIAE

Cowdria ruminantium (Heartwater)	Coxiella burnetti
Rickettsia prowazekii	Rickettsia rickettsii

FUNGI

Coccidioides immitis

PRIONS

Bovine Spongiform Encephalopathy agent

TOXINS

Abrin	Aflatoxin	Botulinum toxins
Clostridium perfringens epsilon	Conotoxin	Diacetoxyscirpenol
Ricin	Saxitoxin	Shigatoxin
Staphylococcal enterotoxins	Tetrodotoxin	T-2 toxin

7.3.1 CDC Select Agent or USDA High Consequence Livestock Pathogens Registration

If your laboratory has a Select Agent please contact the USC Biosafety Officer for assistance with the completion of the required registration forms. Registration with the CDC or USDA is required for laboratories working listed infectious agents or toxins above the exempt quantities.

7.3.2 Transfer of CDC Select Agents or USDA High Consequence Livestock Pathogens

For any transfer of Select Agent the USC Biosafety Officer must be notified prior to any transfer of Select Agent materials. The USC Responsible Official (the Director of Laboratory Safety) must sign the required forms for CDC prior to shipment of Select Agents. If you have any questions regarding the USC Select Agent Policy please contact the USC Biosafety Officer at (323) 442-2208.

8.0 INSTITUTIONAL BIOSAFETY COMMITTEE

The IBC is responsible for ensuring that all research involving (a) infectious agents, (b) human or non-human primate blood, tissue, or body fluids, (c) regulated chemical carcinogens or toxins, (d) recombinant DNA, (e) select agents, or (f) human gene transfer is conducted in compliance with the *NIH Guidelines* and the *Biosafety in Microbiology and Biomedical Laboratories*. The Committee members are responsible for assessing the safety of the research and for identifying any potential risk to public health or to the environment. The members ensure that research personnel are trained and have received the appropriate medical surveillance.

8.1 Research Protocol Registration and Approval Forms

Experiments must be approved by the IBC before work may be initiated. Guidelines for approval are as follows:

- A protocol must be submitted for each project;
- The form may be obtained from Career and Protective Services Web site <http://srm.usc.edu> or from the Biological Safety Officer;
- The form is completed electronically by the Principal Investigator and returned to Laboratory Safety;
- The protocol will be submitted to the Committee for approval;
- The Principal Investigator must have an approved protocol before conducting experiments;
- The approved protocol must be reviewed by all lab personnel and kept in the HMMP binder; and
- All protocols are to be renewed every three years. The PI should notify the BSO immediately if any changes are made to the original protocol.

9.0 MEDICAL SURVEILLANCE

Cite reference

10.0 TRAINING AND COMMUNICATION

All new and indentured employees using biological and/or hazardous materials must attend the Laboratory Safety Course. Subsequent training in the form of the Laboratory Safety Refresher and BBP must be conducted annually.

10.1 Labels and Signs

- Fluorescent orange-red labels displaying the international biohazard symbol and the legend "biohazard" in contrasting colors are attached to containers of biohazardous materials and posted on the laboratory door sign; and

- Labeled red bags are used for biohazardous waste and labeled red containers are used for sharps waste.

11.0 RECORD KEEPING

11.1 Medical Records

Medical records must be established and maintained by designated healthcare provider.

Records are kept confidential and may not be disclosed without the employee's written consent. Records must be kept for the duration of employment and for at least 30 years after the last date of employment.

11.2 Training Records

Training records must be established and maintained. These records should include date of training; contents or summary of training; names, qualifications and signature of trainer(s); names, job titles and signatures of trainees; and a signed statement by trainees that they understand and agree to conduct their work in accordance with the training precepts. This record must be maintained for a minimum of three years from the date of training.

11.3 Availability of Records

Upon request, all records must be made available to the Chief of the Division of Occupational Safety and Health of the California Department of Industrial Relations, NIOSH or a designated representative for examination and copying. In addition, training records must be made available to employees or employee's representative. Upon request, medical records may only be made available to the employee or to someone who has the employee's signed consent.

12.0 APPROVAL AND REVIEW

Date prepared:..... March 1, 2004

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Date revised: July 10, 2006

By: Kathryn Franssen, Alfred M. Bouziane.....