



# **ARKANSAS BIOSCIENCES INSTITUTE**

## **SAFETY INFORMATION**

---

### **BINDER 1: ASU MANUALS**

---

- 1.1. ASU Emergency Procedures Handbook (2011)
  - 1.2. ASU Safety Manual – Maintenance
  - 1.3. ASU Biological Safety Manual (2007)
  - 1.4. ASU Environmental Chemical & Laboratory Compliance Manual (2003)
  - 1.5. ASU Radiation Safety Manual (2012)
- 

October 2014.

ARKANSAS STATE UNIVERSITY

# EMERGENCY PROCEDURES

## HANDBOOK

THIS GUIDE COVERS:  
GENERAL EMERGENCY PROCEDURE  
MEDICAL EMERGENCY  
EARTHQUAKE  
SEVERE WEATHER  
FIRE

CHEMICAL LEAK/SPILL/DISPOSAL/BIOLOGICAL ( MEDICAL )  
DISTURBANCE/DEMONSTRATION/CRIMINAL BEHAVIOR/ACTIVE SHOOTER  
BOMB THREAT  
EXPLOSION  
SHELTER IN PLACE  
EVACUATION PROCEDURES  
EMERGENCY EVACUATION CHECK POINTS  
BLUE LIGHT EMERGENCY PHONES  
CAMPUS MAP



---

Page intentionally left blank

## GENERAL EMERGENCY PROCEDURES

### REPORT EMERGENCIES TO: .....9-9-1-1

University Police Department .....	972-2093
Facilities Management.....	972-2066
Environmental Health & Safety.....	972-2862

When calling, stay calm and carefully explain the problem and location. Do not hang up until told to do so.

### PUBLIC STATEMENTS

Statements to the news media will be made by the University Communications Office in coordination with appropriate emergency officials. Statements to family members will be made by the Human Resources Office (concerning employees) or Student Affairs Office (concerning students).

### EMERGENCY EMPLOYMENT, PURCHASING AND CONTRACTING

There are no provisions for suspension of state laws in an emergency. The ranking university official on the scene shall attempt to comply with laws if possible and shall maintain records where threat to life and property require extraordinary action.

### EMERGENCY & RESOURCE NUMBERS

City Water & Light .....	930-3300
St. Bernards Medical Center .....	972-4100
CenterPoint Energy .....	800-992-7552
NEA Baptist Memorial Hospital .....	972-7000
State Police .....	935-7302
National Guard.....	935-2401
County Judge .....	933-4500
Army Reserve .....	933-9405
Fire Department .....	935-5551
Highway Department.....	932-2339
Jonesboro Police.....	935-5553
-OR-.....	239-9511
Sheriff's Department .....	933-4550
American Red Cross .....	932-3212
Ambulance.....	9-9-1-1
Salvation Army .....	932-3785
Office of Emergency Services .....	933-4575

## **MEDICAL EMERGENCY**

### **HELP!!**

EMS .....9-911  
University Police.....972-2093  
Student Health Center.....972-2054

### **WHEN TO CALL!** – If any of the following are happening:

- Unresponsiveness
- Difficulty Breathing
- Chest Pain
- Seizures
- Profuse Bleeding

### **DO NOT OVERREACT.**

Most situations can be handled on site or by private transport to seek medical care. Do not hesitate to call an ambulance if the medical condition requires immediate medical attention. Additional help may be available from these departments:

Nursing Department.....972-3074  
Environmental Health & Safety .....972-2862  
HPESS Center.....972-3066  
Athletic Trainer.....972-3342

### **LABORATORY EMERGENCIES.**

Utilize procedures established by the responsible department. Procedures are posted in each lab.

### **SHOP ACCIDENTS.**

Utilize procedures established by the responsible department. Procedures are posted in each shop.

### **ASU Employee Procedures.**

Employees, who become ill or injured, because of an occurrence during the course of their employment, are required to notify their direct supervisor. They are to seek medical attention at the Student Health Center. Call 9-911 if the employment-related illness or injury requires immediate medical attention.

# **EARTHQUAKE**

## **Indoors:**

Seek refuge in a doorway or under a desk or table. Stay away from glass windows, shelving and heavy equipment.

## **Outdoors:**

Move away from buildings and utility poles. AVOID DOWNED UTILITY LINES. When shaking stops: Evacuate buildings and do not re-enter due to danger of aftershocks. Stay away from buildings. Do not block streets as a pedestrian or with your car. Streets must remain open for emergency vehicles.

## **DO NOT USE ELEVATORS**

## **ASSIST HANDICAPPED AND ANY INJURED**

## **Utilities:**

Facilities Management will shut off gas and electricity.

## **Fire and Rescue:**

University Police will direct rescue operations. (See “General Emergency Procedures” page)

## **FOOD AND SHELTER**

- Food Service will secure food supplies and ration as situation dictates.
- Facilities Management will valve off hot water tanks and swimming pool for emergency drinking water.
- Residence Life will assign quarters in undamaged buildings (See “General Emergency Procedures” page).
- Medical Personnel will establish first aid station and morgue as required in available buildings.

## **COMMUNICATIONS:**

University Police Radios  
Facilities Management Radios  
Environmental Health & Safety Radios  
Convocation Center Radios  
Parking Services Radios  
C.B. Radios  
Cell Phones

## SEVERE WEATHER

### TORNADO

- **INFORMATION** on Severe Weather is broadcast on KASU 91.9 FM and provided through the Emergency Alert System.
- **TORNADO WATCH** means that a tornado is possible. Remain alert for approaching storms.
- **TORNADO WARNING** means that a tornado has been sighted. Danger exists. Move to a place of safety.
- **SIRENS** are sounded by local authority and indicate a tornado warning. Take shelter. Sirens at noon on a clear day are only a test.
- **SHELTER.** Basement and ground floor interiors of major buildings afford the best protection. Stay away from windows. The University Police Department will unlock Arkansas Hall and Laboratory Sciences Building during warnings. Custodians will assist when on duty.
- **ALL CLEAR.** Verbal “All Clear” will be sounded by University Police Department and transmitted through the Emergency Alert System. University Police will re-lock buildings.

### THUNDERSTORM

- **SEVERE THUNDERSTORM WATCH** means that thunderstorms are possible in the area. Remain alert for approaching storms.
- **SEVERE THUNDERSTORM WARNING** means thunderstorms are occurring in the area or indicated by weather radar.
  - Lightning strikes pose one of the greatest thunderstorm-related risks
  - Don't carry or go near anything made of metal. Lightning is attracted to metal
  - Stay away from doors and windows
  - Don't use the telephone unless it is an emergency. Lightning can travel through phone lines
  - Don't go under a large tree, tower, or other structure that stands alone. Lightning can be attracted to it because of its height.

## **FIRE**

Notes and Precautions: A fire emergency exists whenever there is the presence of smoke or the odor of burning, when there is an uncontrolled fire or imminent fire hazard in the building or surrounding area, where there is a spontaneous or abnormal heating of any material, or when the fire alarm is sounding.

Only use a fire extinguisher if the fire is very small and you know how to operate the fire extinguisher safely. If you can't put out the fire, leave immediately and call 9-911 or 911. Total and immediate evacuation is safest.

### **FIRE EMERGENCY PROCEDURE**

- ACTIVATE FIRE ALARM
- CALL 9-9-1-1

### **REPORT TO:**

University Police .....972-2093  
Facilities Management .....972-2066  
Environmental Health & Safety .....972-2862

- MINOR FIRE that appears controllable:
  - Pull Safety Pin from handle of fire extinguisher
  - Aim nozzle at base of Fire
  - Squeeze the trigger handle
  - Sweep from side to side at base of Fire
- MAJOR FIRE that does not appear controllable
  - Leave the building (evacuate in accordance with building procedures and evacuate at least 300 feet away from building).
  - Use marked exits.

### **ASSIST THE HANDICAPPED – DO NOT USE ELEVATORS**

- Close but DO NOT LOCK doors.
- Do not return to the building until cleared by Fire or Police Departments.



## CHEMICAL LEAK/SPILL/DISPOSAL/BIOLOGICAL (MEDICAL)

### Notes and Precautions:

The nature and quantity of hazardous substances used in laboratories requires preplanning to respond safely to chemical spills. The clean-up of a chemical spill should only be done by knowledgeable and experienced personnel. Spill kits with instructions, absorbents, protective equipment and disposal bags and labels should be available to clean up minor spills. A minor chemical spill is one that the laboratory staff is capable of handling safely without the assistance of Environmental Health & Safety or emergency personnel. All other chemical spills are considered major.

**CHEMICAL LEAK** Large quantities (i.e., Drums, Tanks, Pipes).

### Notify:

Environmental Health & Safety .....972-2862  
Facilities Management.....972-2066  
University Police .....972-2093

### ASSIST THE HANDICAPPED TO EVACUATE

- Chemical Spill – Small quantities (i.e. laboratory quantities). Spill kits are available from Environmental Health & Safety at 972-2862.

### MINOR CHEMICAL SPILL PROCEDURES

- Notify Responsible Department.
- Alert people in immediate area of spill.
- Wear protective equipment including chemical splash goggles, appropriate gloves and lab coat.
- Avoid breathing vapors from spill.
- Confine spill to small area. Use appropriate spill kit to absorb the spilled material.
- Bag clean-up material and label it with the Hazardous Waste label and call Environmental Health & Safety for a pick-up.
- Clean spill area with water.

## RADIATION SPILL

### Notes and Precautions:

Spreading of radiation beyond the spill area can easily occur by the movements of personnel involved in the spill or clean-up effort. Prevent spread by confining movements of personnel until they have been monitored and found free of contamination. Do Not perform remedial actions without the assistance of trained personnel.

### RADIATION SPILL PROCEDURES

- Notify personnel in the immediate area of the spill.
- Confine the spill immediately.
- Have all potentially contaminated personnel stay in one area until they have been monitored and shown to be free of contamination.

### Notify:

Radiation Safety Officer .....972-3082  
Environmental Health & Safety .....972-2862  
University Police .....972-2093

- Attempt clean-up ONLY if you have received appropriate training.

## **DISTURBANCE – DEMONSTRATION – CRIMINAL BEHAVIOR – ACTIVE SHOOTER**

**DEMONSTRATION. Notify: University Police .....972-2093**

**DO NOT OVERREACT.** Most will be peaceful.

- Secure documents and equipment.
- Avoid provoking or obstructing demonstrators.
- Carry on normal activities if possible.
- If the disturbance is outside, stay away from doors or windows. **STAY INSIDE!!!!**

**CRIMINAL BEHAVIOR. Notify: University Police.....972-2093**

- **Gunfire.** Take cover or evacuate.
- **Hostage.** Do not attempt to fight back. Make mental notes of captor's characteristics, sights and sounds if you are taken from campus. Make mental notes for possible escape avenues. University Police Department will involve other law enforcement agencies as necessary.
- **Active Shooter.** Secure immediate area:
  - Lock and barricade doors.
  - Turn off lights and all audio equipment.
  - Stay away from the windows. Do not try to "see what's happening."
  - Do not sound the fire alarm. A fire alarm would signal the occupants to evacuate the building and thus place them in potential harm as they attempt to exit.
  - Remain calm and out of sight.
  - Take adequate cover or protection. Secure yourself behind concrete walls, thick desks, filing cabinets. Cover may protect you from bullets.
  - Silence cell phones.
  - Place signs in exterior window to identify the location of injured persons.

### **Un-Securing an area:**

- Keep classrooms secure until police personnel arrive and give you directions.
- Attempts to rescue people should only be attempted if it can be accomplished without further endangering the persons inside a secured area.
- Consider the safety of masses vs. the safety of a few.
- If doubt exists for the safety of the individuals inside the room, the area should remain secured.

### **Contacting Authorities:**

- Dial 9-911 from on-campus phone.
- Dial 911 from off-campus or cell phone.
- Dial 870-972-2093 to contact the University Police Department.
- Email at [upd@astate.edu](mailto:upd@astate.edu)
- Be aware that the 911 system may be overwhelmed during a time of crisis.
- Program the University Police Department's phone number into your cell phone or consider e-mail as an option. E-mail may be an option when unable to speak.

### **What to Report:**

- Your specific location: building name and office/room number.
- Number of people at your specific location.
- Injuries: number injured and types of injuries.
- Assailant(s): location, number of suspects, race/gender, clothing description, physical features, type of weapons, such as long gun, hand gun, or knife, backpack or other bags, shooter's identity if known, number of shots fired, any other information to assist authorities in identifying assailant.

### **Police action:**

In the event of an actual active shooter incident, it is important to understand the responsibilities and immediate action of the University Police and local law enforcement. University Police will immediately respond to the threat. This will be to eliminate the threat or contain the suspect in a safe area. Jonesboro S.W.A.T. will be activated to achieve the same goals.

Time is of the essence and the fewer people roaming or running around, the better our chance of locating the shooter. The 911 systems and our dispatch system will be overwhelmed with phone calls. It needs to be stressed that only people who can give the location of the shooter need to be calling. People calling the emergency services for any other reason are hindering the speed and ability of law enforcement to locate the shooter and provide medical services.

## BOMB THREAT

- Bomb Threat – Remain Calm – Keep Caller on Phone

### Ask the Caller: (Take Caller Seriously)

When is the bomb to explode?    Where is the bomb located?    What kind of a bomb?  
What does it look like?    What will cause it to explode?    Where are you calling from?  
What is your address?    What is your name?

Sex of Caller \_\_\_\_\_ Age \_\_\_\_\_ Race \_\_\_\_\_ Length of Call \_\_\_\_\_

### Caller's Voice:

Calm	Nasal	Slow	Raspy	Loud	Angry
Cracked	Slurred	Laughter	Normal	Lisp	Stutter
Excited	Rapid	Deep	Soft	Accent	Broken
Stressed	Disguised	Distinct	Sincere	Squeaky	Crying
Clearing Throat		Deep	Breathing		
OTHER	_____				

### Background Sounds:

Street Noises	Factory Machinery	Animal Noises
Other Voices	P.A. System	Static
Music	Motor	Office Machinery
Long Distance	Local	
OTHER	_____	

Time Caller Hung Up \_\_\_\_\_ Department Receiving Call \_\_\_\_\_  
Person Receiving Call \_\_\_\_\_

## CALL UNIVERSITY POLICE IMMEDIATELY .....972-2093

### ACADEMIC/ADMINISTRATIVE BUILDINGS MUST PULL FIRE ALARM IMMEDIATELY UPON RECEIVING BOMB THREAT

- Notify University Police – 972-2093. Give your name, location and telephone number. Inform the Dispatcher of the situation and provide information obtained from the call.
- Inform your supervisor, department head and/or hall director.

### UPON ARRIVAL OF THE POLICE:

- Cooperate fully with the police officers and provide them with as much information as possible.
- You may be asked to make a quick search of those areas in your office, classroom, lab or residence hall room with which you are most familiar.
- If you should spot a suspicious object or package, report it to authorities immediately. Under no circumstances should you touch it, tamper with it, or move it in any way.

### BUILDING EVACUATION

- All building evacuations will occur when an alarm sounds continuously and/or upon direction of the University Police or other emergency services personnel.
- All faculty, staff, students and visitors will IMMEDIATELY evacuate the building. Information regarding the nature of the emergency will be provided once occupants are outside. EVACUATE AT LEAST 300 FEET AWAY FROM THE FACILITY.
- Move quickly to the nearest marked exit and alert others to do the same.

### ASSIST THE HANDICAPPED – DO NOT USE ELEVATORS

- University Police will conduct a search and announce "All Clear."
- Do not return to building until "All Clear" is given.

## EXPLOSION

- Sound Fire Alarm
- Evacuate Building (**DO NOT USE ELEVATORS**)

### ASSIST THE HANDICAPPED TO EVACUATE - (DO NOT USE ELEVATORS)

- Notify  
University Police.....972-2093  
Facilities Management.....972-2066  
Environmental Health & Safety..... 972-2862
- Do Not Re-enter building until "All Clear."

## PSYCHOLOGICAL CRISIS

A psychological crisis exists when an individual is threatening harm to himself/herself or to others, or is out of touch with reality. A psychotic break may be manifested by hallucinations or uncontrollable behavior.

### If a psychological crisis occurs on campus:

- Monday through Friday 8:00 am – 5:00 pm, call the Counseling Center at 972-2318. A counselor will respond to your location. After hours, call the University Police Department at 972-2093. A counselor will be notified and will respond.
- In a life-threatening emergency situation (i.e. involving a weapon), immediately notify UPD and provide your name and location so officers can respond to the situation. UPD personnel will notify the Counseling Center when necessary.
- The Associate Vice Chancellor for Student Affairs may be contacted. This will be in accordance with the University policy.

Students experiencing a severe psychological crisis should go to the nearest hospital emergency room or contact Arkansas State University's Counseling Center which provides individual and group counseling to currently enrolled ASU students. Its professionally trained staff seeks to assist students with social, emotional, and academic concerns in a sensitive, caring, and confidential manner.

**Note:** There are psychological consequences to every emergency. The Counseling Center is available to assist with post traumatic stress in all situations.

## SHELTER-IN-PLACE

In the unlikely event of an accidental or intentional release of hazardous chemicals or biological agents in the area, the best action may be to shelter in place. The following are guidelines to follow if sheltering in place is advised.

- The University Police Department and local emergency services will use every means available to advise the University Community of imminent dangers. Media that may be used by UPD and local emergency services includes email, ASU website (<http://www.astate.edu>), telephone, KASU, local radio and television stations, and the Emergency Alert System.
- Turn off the heating or air conditioning in your area if you have the means to do so. The Facilities Management Department will turn off all main air handlers and exhaust systems.
- Do not use the elevators. Elevators can become stuck when air handlers are turned off.
- Seek shelter on floors above ground level and in the interior part of the building in an area with the least amount of windows and doors.
- After everyone has settled, use material such as plastic and tape to seal doorways.
- Wait for further instructions from the University Police Department or other emergency personnel.
- Use phones only for an emergency. Overuse of phones, including cellular, can overburden the system and delay emergency calls.
- It is highly suggested that all departments invest in a small battery-powered radio in case electricity is lost.
- Once the emergency is over, you will be instructed to evacuate the building.

## EVACUATION

### • CAMPUS-WIDE EVACUATION

A campus-wide evacuation may be ordered by off-campus authorities or ranking University Police Officer on duty. Evacuation will be announced by University Police.

KASU 91.9 FM, campus cable TV, and the Emergency Alert System will broadcast the evacuation order. University Police will direct traffic.

#### Four (4) locations are available based on situation:

Jonesboro High School Gym .....	933-5800
Nettleton High School Gym .....	910-7805 ext. 229
Performing Arts Center (Nettleton High).....	910-7805 ext. 229
Brookland High School Gym.....	932-2080

Commuters and non-emergency staff shall use personal vehicles to go home unless their home is in the danger zone.

**No Vehicle?** Hitch a ride.

**No Ride?** Report to the Student Union. Facilities Management personnel will use available university vehicles to shuttle persons to safety.

- University Police will dispatch an officer to the selected evacuation site, or sites, for control and communication. Student Affairs, University Police, Information & Technology Services, and Environmental Health & Safety will send representatives to the evacuation site, or sites.
- Administrative personnel will arrange for food and housing or further evacuation based on the situation.
- University Police will maintain on-campus security as long as personal safety allows.
- “All Clear” will be announced by University Police with follow-up by KASU 91.9 FM.

## EVACUATION PROCEDURES

### Building Evacuation

- An Evacuation of a building is used to move persons out of a building to avoid a potentially threatening situation.
- Upon the sounding of the fire alarm or notification by the Emergency Alert System, everyone will evacuate a building.
- When evacuating a building leave quickly, but calmly, by the nearest exit or stairwell. Alert others to do the same. **DO NOT USE THE ELEVATOR.**
- Do not return to your area to collect personal items prior to evacuating.
- Close doors behind you while exiting.
- You may walk briskly but do not run.
- Do not go to the restroom.
- If smoke is present, stay low. The best quality air is near the floor.
- Develop a plan now to make sure everyone in your office/area is aware of how and when the plan is to be implemented.
- Report any missing persons to the University Police and provide the location where last seen.
- **DO NOT** return to an evacuated building until authorized to do so by University Police.
- Assist persons with a mobility, visual or hearing impairment to the nearest exit or stairwell. Alert University Police or Fire department personnel of persons with a mobility impairment left in the building.

### Persons with a Mobility Impairment

- Prepare to be assisted during a building evacuation.
- Proceed to the nearest stairwell or exit if available. **DO NOT USE ELEVATOR** in the event of fire or power failure.
- Persons with a mobility impairment should be calm and remain at the exit or stairwell until assistance arrives. Make sure you inform other evacuees of your location.

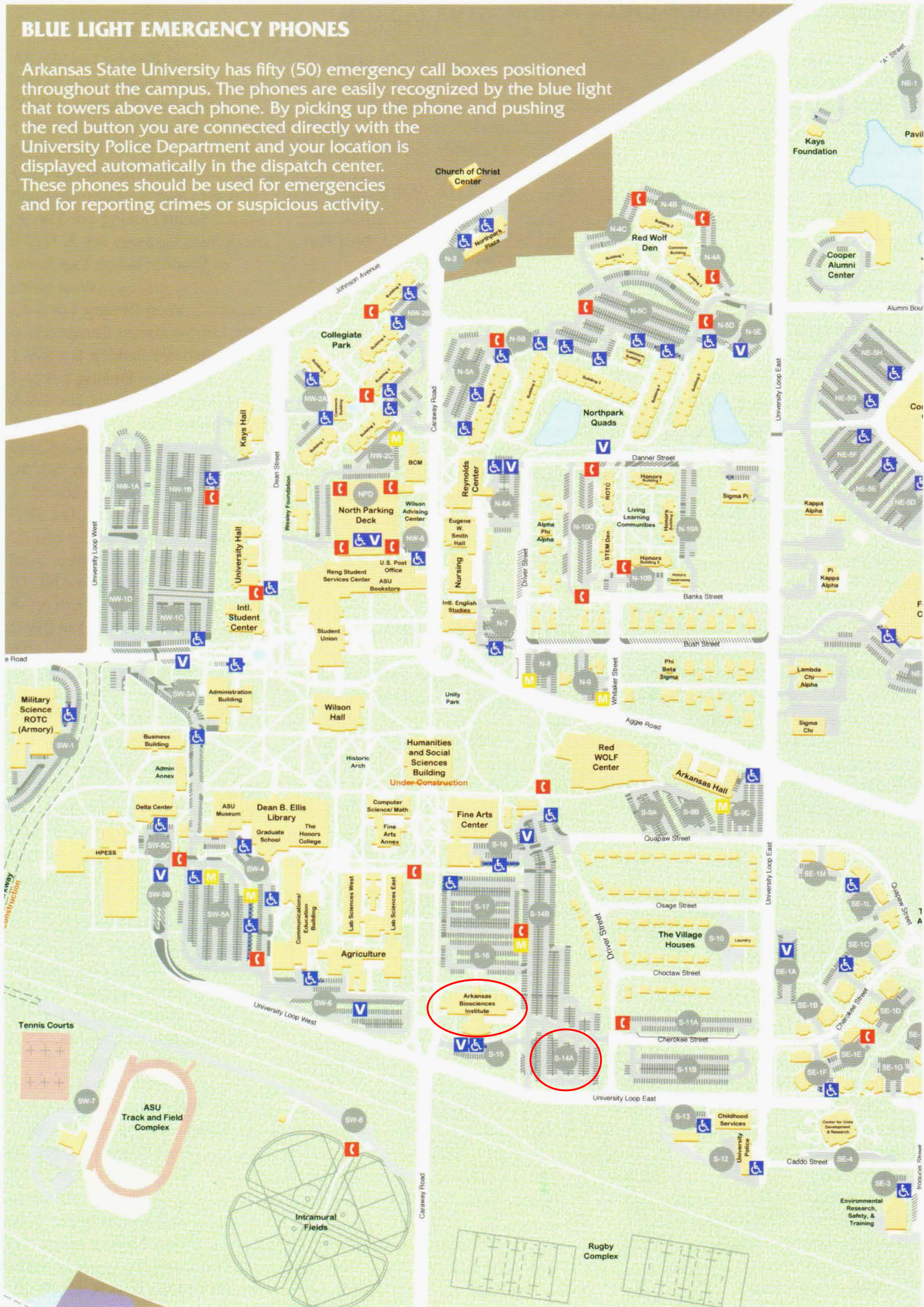
## EMERGENCY EVACUATION CHECK POINTS

Administration .....	West Parking Lot SW-3A
Arkansas Biosciences Institute .....	East Parking Lot S-14A
Arkansas Hall .....	Southeast Parking Lot S-9C
Armory.....	East Parking Lot SW-1
Art Annex .....	North Lawn/Quad
Baseball Complex .....	North Parking Lot NE-7
Carl R. Reng Center/Student Union.....	East Lawn/By Caraway Road
Delta Center for Economic Development .....	South Parking Lot SW-5C
Eugene Smith Hall .....	West Parking Lot/Across Caraway Rd. & NW-6 or Student Union East Lawn
Childhood Development & Research Center .....	West Lawn
Childhood Services.....	West Parking Lot S-13
College Of Agriculture .....	South Parking Lot/Southeast Corner SW-6
College of Business .....	Armory Parking Lot SW-1
College of Nursing & Health Professions .....	Southeast Parking Lot N-7
Colleges of Education & Communication.....	West Parking Lot/ Library Lot SW-5
Collegiate Park.....	Adjoining Parking Lots NW-2A, 2B, 2C
Computer, Science & Math.....	North Lawn/Quad
Convocation Center .....	East Parking Lot NE-5A, 5B, 5C
Cooper Alumni Center .....	South Parking Lot NE-4
Environmental Health, Safety & Research .....	North Parking Lot SE-3
Facilities Management .....	West & North Parking Lots Se-2A, 2C
Fine Arts.....	South Parking Lot S-18
Football Field House .....	South Parking Lot NE-3B
Fowler Center .....	South Parking Lot NE-8
Health, Phys. Education & Sports Sciences.....	South Parking Lot SW-2
Honors Living/Learning Community.....	South & East Parking Lots N-10B, N-10A
Information & Technology Services .....	West Parking Lot SE-2B
International English Studies Building .....	East Parking Lot N-7
International Student Center .....	West Parking Lot NW-1C
Judd Hill Foundation .....	South Parking Lot
Kays Hall .....	West Parking Lot NW-1B
Lab Science East .....	East Parking Lot/Across Caraway Rd. S-17
Lab Science West .....	Events Lawn/Amphitheater
Laundry.....	North Parking Lot S-10
Library.....	South Parking Lot/Southwest Corner SW-5 & North Lawn/Quad
Museum .....	South Parking Lot/Southwest Corner SW-5
North Park Plaza .....	North Parking Lot N-3
North Park Quad .....	North Parking Lots N-5A, 5B, 5C, 5D
Parking Garage.....	North Parking Lot NW-2C
Pavilion.....	North Parking Lot NE-1
Post Office .....	North Parking Lot S-7
Red Wolf Recreation Center .....	South Parking Lot S-9A
Reynolds Center for Health Sciences .....	East Parking Lot N-6A
Residence Life Warehouse.....	North Parking Lot S-13
ROTC/STEM Living/Learning Community .....	West Parking Lot N-10C
Soccer Complex .....	Southwest Parking Lot NE-2
Student Health Center .....	West Parking Lot NE-3B
Track Complex .....	North Parking Lot SW-7
University Hall.....	North Lawn
University Police Department .....	West Parking Lot S-12
Wilson Advisement Services .....	South Parking Lot NW-6
Wilson Hall .....	East Lawn/By Caraway Road
Wolf Den Apartments.....	North & South Parking Lots N-4C, N-4B,

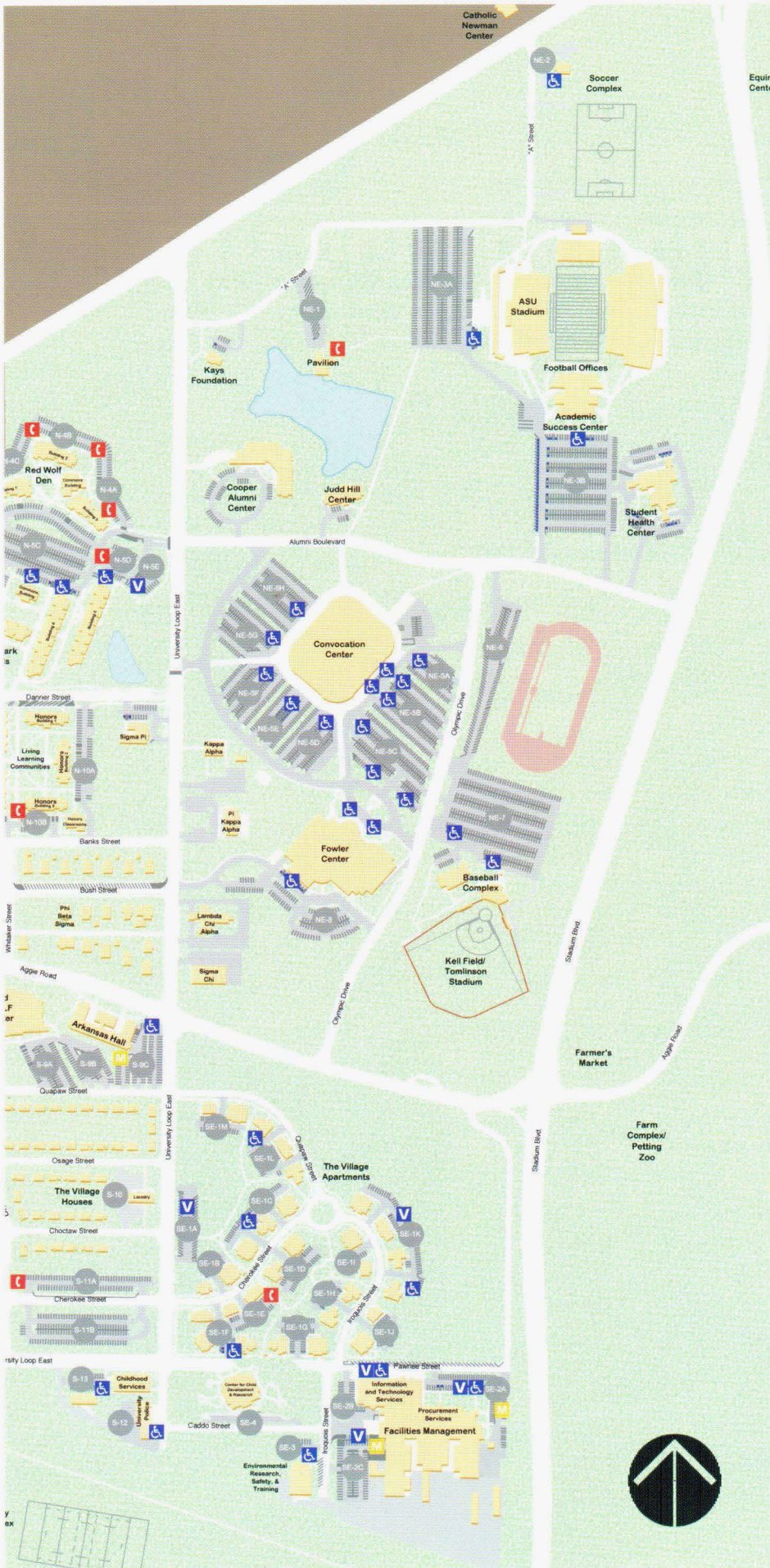


# BLUE LIGHT EMERGENCY PHONES

Arkansas State University has fifty (50) emergency call boxes positioned throughout the campus. The phones are easily recognized by the blue light that towers above each phone. By picking up the phone and pushing the red button you are connected directly with the University Police Department and your location is displayed automatically in the dispatch center. These phones should be used for emergencies and for reporting crimes or suspicious activity.







## Emergency Phone Locations

- Arkansas Hall
- Kays Hall
- Lab Science
- Lot S17
- Lot S11
- Lot SW5
- Lot NW-1B
- Honors
- Honors
- Honors
- Honors
- SE corner of University Hall
- SW Collegiate Park Building 3
- SW Collegiate Park Building 5
- NW Red Wolf Den Building 2
- NE Red Wolf Den Building 3
- Married Student Housing
- North Park Quad Lot East
- North Park Quad Lot Central
- North Park Quad Lot West
- Parking Deck Floor 1NW
- Parking Deck Floor 1SW
- Parking Deck Floor 1SE
- Parking Deck Floor 1NE
- Parking Deck Floor 2NW
- Parking Deck Floor 2SW
- Parking Deck Floor 2SE
- Parking Deck Floor 2NE
- Parking Deck Floor 3NW
- Parking Deck Floor 3SW
- Parking Deck Floor 3SE
- Parking Deck Floor 3NE
- Pavilion
- Red Wolf Rec. Center
- Track
- Wolf Den Apt. A1E
- Wolf Den Apt. A1W
- Wolf Den Apt. A2E
- Wolf Den Apt. A2W
- Wolf Den Apt. A3E
- Wolf Den Apt. A3W
- Wolf Den Apt. B1E
- Wolf Den Apt. B1W
- Wolf Den Apt. B2E
- Wolf Den Apt. B2W
- Wolf Den Apt. B3E
- Wolf Den Apt. B3W
- Wolf Den Apt. C1E
- Wolf Den Apt. C1W
- Wolf Den Apt. C2E
- Wolf Den Apt. C2W
- Wolf Den Apt. C3E
- Wolf Den Apt. C3W
- Wolf Den Apt. N4A
- Wolf Den Apt. N4B
- Wolf Den Apt. N4C

There are also emergency phones in all elevators located on campus.







**ARKANSAS STATE  
UNIVERSITY**

---

# **SAFETY MANUAL**

**(MAINTENANCE)**



***ARKANSAS STATE UNIVERSITY  
JONESBORO, ARKANSAS***

## INTRODUCTION

---

This manual is a guide for establishing and maintaining safe working conditions at Arkansas State University, and for promoting safe work practices by administration and employees. It explains Arkansas State University's Safety Policy, general safety rules and your rights to Workers' Compensation Insurance Benefits if you are injured on the job.

Arkansas State University recognizes its responsibility to provide a safe and healthful working environment. This shall include making reasonable efforts to promptly investigate and address health and safety issues, not requiring employees to perform tasks that are dangerous to their health and safety without adequate training and safety equipment as determined by applicable state and federal laws, and making information on hazardous materials readily accessible. All employees will adhere to operating practices and procedures designed to prevent illness and injury and will observe all Federal, State and University safety regulations.

It is our sincere hope that you will never be injured. If you are injured, however, we want you to receive the best medical care without delay. If you delay in reporting an injury, we cannot do our part. Report all accidents immediately to your supervisor. Report the accident even if medical treatment is not necessary.

Please read this entire guide carefully and refer to it whenever you have a question. It is dedicated to helping you work safely on the job. If a question is not answered in the guide, or if you have any additional questions, please contact the Environmental Health and Safety Department for assistance.

<b>1. DUTIES AND RESPONSIBILITIES .....</b>	<b>6</b>
1.1. ENVIRONMENTAL HEALTH AND SAFETY DEPARTMENT.....	6
1.1.1. <i>Duties and Responsibilities</i> .....	6
1.2. ADMINISTRATION, DEANS, AND DEPARTMENT HEADS.....	7
1.2.1. <i>Duties and Responsibilities</i> .....	7
1.3. UNIVERSITY SAFETY COMMITTEE.....	8
1.3.1. <i>Duties and Responsibilities</i> .....	8
1.4. SUPERVISORS .....	8
1.4.1. <i>Duties and Responsibilities</i> .....	9
1.5. UNIVERSITY EMPLOYEE'S.....	10
1.5.1. <i>Duties and Responsibilities</i> .....	10
1.6. DEPARTMENTAL SAFETY COMMITTEE .....	11
1.6.1. <i>Duties and Responsibilities</i> .....	11
1.7. RESPONSIBILITIES OF OFF-CAMPUS FACILITIES AND ORGANIZATIONS .....	11
1.8. CONTRACTOR COMPLIANCE.....	12
<b>2. UNIVERSITY SAFETY RULES .....</b>	<b>12</b>
2.1. GENERAL SAFETY RULES .....	12
2.2. HOUSEKEEPING REQUIREMENTS .....	13
<b>3. FIRE PREVENTION AND SAFETY.....</b>	<b>14</b>
3.1. FIRE PREVENTION MEASURES .....	14
3.2. EMERGENCY PROCEDURES.....	15
3.3. TRAINING FOR FIRE SAFETY .....	16
<b>4. LIFTING AND CARRYING.....</b>	<b>16</b>
4.1. RULES FOR LIFTING AND CARRYING .....	16
4.2. TRAINING FOR MANUAL MATERIAL HANDLING.....	17
<b>5. LADDERS, SCAFFOLDS AND WORK PLATFORMS.....</b>	<b>17</b>
5.1. LADDERS, SCAFFOLDS AND WORK PLATFORM GUIDELINES .....	17
<b>6. MACHINE SAFEGUARDING .....</b>	<b>18</b>
6.1. GENERAL RULES .....	19
6.2. HAND AND POWER TOOLS.....	19
<b>7. ELECTRICAL SAFETY .....</b>	<b>21</b>
7.1. GENERAL ELECTRICAL SAFETY.....	21
7.2. LOCKOUT/TAGOUT PROCEDURES.....	22
7.3. ELECTRICAL SAFETY TRAINING REQUIREMENTS .....	22
<b>8. TRENCHING, SHORING AND EXCAVATION .....</b>	<b>22</b>
8.1. TRENCHING, SHORING AND EXCAVATION GUIDELINES.....	23
8.2. TRAINING FOR TRENCHING, SHORING AND EXCAVATION .....	23
<b>9. RESPIRATORY PROTECTION .....</b>	<b>23</b>
9.1. RESPIRATOR USAGE REQUIREMENTS .....	24
9.2. RESPIRATOR TRAINING .....	24
9.3. RECORDKEEPING .....	24
<b>10. FALL PROTECTION.....</b>	<b>24</b>
10.1. FALL PROTECTION GUIDELINES .....	25
10.2. FALL PROTECTION TRAINING .....	25

10.3.	INSPECTIONS .....	25
<b>11.</b>	<b>WELDING .....</b>	<b>26</b>
11.1.	WELDING EQUIPMENT.....	26
11.2.	TRAINING REQUIREMENTS FOR WELDING.....	26
11.3.	FIRE PREVENTION .....	26
11.4.	VENTILATION PROCEDURES FOR WELDING.....	26
<b>12.</b>	<b>PERSONAL PROTECTIVE EQUIPMENT.....</b>	<b>27</b>
12.1.	PERSONAL PROTECTIVE EQUIPMENT GUIDELINES.....	27
12.2.	EYE AND FACE PROTECTION .....	27
12.3.	HEAD PROTECTION.....	27
12.4.	HAND PROTECTION .....	27
12.5.	FOOT PROTECTION .....	28
12.6.	HEARING PROTECTION .....	28
12.7.	RESPIRATORY PROTECTION.....	28
12.8.	PPE TRAINING .....	28
12.9.	PPE INSPECTIONS.....	28
<b>13.</b>	<b>COMPRESSED GAS CYLINDERS.....</b>	<b>28</b>
13.1.	STORAGE AND USE GUIDELINES.....	29
13.2.	COMPRESSED GAS CYLINDER TRAINING.....	29
<b>14.</b>	<b>CONFINED SPACES.....</b>	<b>29</b>
14.1.	TRAINING .....	30
14.2.	SUPERVISOR RESPONSIBILITIES .....	30
<b>15.</b>	<b>HEAT RELATED INJURIES.....</b>	<b>30</b>
15.1.	HEAT STRESS .....	30
<b>16.</b>	<b>ACCUTE HEAT DISORDERS (ILLNESSES) .....</b>	<b>31</b>
16.1.	HEAT RASH .....	31
16.2.	TRANSIENT HEAT FATIGUE .....	31
16.3.	HEAT SYNCOPE (FAINTING) .....	31
16.4.	HEAT CRAMPS.....	31
16.5.	HEAT EXHAUSTION .....	32
16.6.	HEAT STROKE .....	32
16.7.	ACCLIMATIZATION.....	33
<b>17.</b>	<b>RADIATION SAFETY .....</b>	<b>33</b>
17.1.	INSPECTIONS .....	33
<b>18.</b>	<b>BLOODBORNE PATHOGENS.....</b>	<b>33</b>
18.1.	DEFINITION .....	34
18.2.	OCCUPATIONAL EXPOSURE.....	34
18.3.	CONTROL MEASURES .....	34
18.4.	CLEAN UP OF BLOOD SPILLS.....	35
18.5.	EXPOSURE GUIDELINES.....	35
<b>19.</b>	<b>CHEMICAL RIGHT-TO-KNOW .....</b>	<b>35</b>
19.1.	EMPLOYERS' RESPONSIBILITIES .....	35
19.2.	EMPLOYEE RIGHTS.....	36
<b>20.</b>	<b>OFFICE SAFETY .....</b>	<b>36</b>
20.1.	WORKSTATION ERGONOMICS.....	36

20.1.1.	<i>Work Positions</i> .....	37
20.1.2.	<i>Reducing Back Strain</i> .....	37
20.1.3.	<i>Minimizing Stress and Strain</i> .....	37
20.2.	FIRE SAFETY IN THE OFFICE.....	38
20.2.1.	<i>Preventing Electrical Fires</i> .....	39
20.3.	SLIPS, TRIPS AND FALLS.....	39
20.3.1.	<i>SLIPS</i> .....	39
20.3.2.	<i>TRIPS</i> .....	40
20.3.3.	<i>FALLS</i> .....	40
20.4.	FILING CABINETS/BOOKCASES.....	40
<b>21.</b>	<b>WORK RELATED INJURIES/ILLNESSES .....</b>	<b>41</b>
21.1.	REPORTING ON THE JOB INJURIES.....	41
21.2.	MEDICAL TREATMENT FOR WORK RELATED INJURIES/ILLNESSES.....	41
21.3.	REQUIRED DOCUMENTATION FROM TREATING PHYSICIAN .....	42
21.4.	FALSE REPRESENTATION.....	42
21.5.	ACCIDENT/INCIDENT REPORTS AND ANALYSIS .....	42
<b>22.</b>	<b>SAFETY AND HEALTH AUDITS.....</b>	<b>42</b>
22.1.	REGULATORY AGENCY INSPECTIONS.....	42
<b>23.</b>	<b>UTILITY AND SLOW MOVING VEHICLE SAFETY AND TRAINING PROGRAM.....</b>	<b>44</b>
23.1	STATEMENT OF POLICY.....	44
<b>APPENDIX A - TRAINING PROGRAMS.....</b>		<b>48</b>

# **1. DUTIES AND RESPONSIBILITIES**

Arkansas State University's Safety Program has been designed to make safety everyone's business. This section of the manual has been developed to provide employees with assistance toward their safety responsibility.

## ***1.1. Environmental Health and Safety Department***

The Environmental Health and Safety Department is responsible for the planning, implementation and administration of the campus policies for the Universities Safety and Health Program. The Environmental Health and Safety Department shall be the primary source for reviewing and interpreting new codes and regulatory guidelines as established by Federal, State and Local agencies, and identifying their applicability to the various University operations. The Environmental Health and Safety Department is the agent, which represents the University when dealing with external agencies concerned with workplace health and safety.

A primary function of the Environmental Health and Safety Department is to assist the University's Administration, Deans, Department Chairs, Directors and Supervisors in meeting their assigned responsibilities in relation to the University's Safety Program. The Environmental Health and Safety Department shall provide technical and administrative support to each operating unit to assist in identifying, developing and implementing proactive rules and procedures designed to reduce or eliminate potential risks and hazards that could adversely impact the safety and well-being of the University community and its neighboring communities.

### **1.1.1. Duties and Responsibilities**

Specific responsibilities of the Environmental Health and Safety Department include, but are not limited to:

1. Serve as the University's primary liaison with all regulatory agencies responsible for safety and health standards, codes and guidelines.
2. Assure that no University operation or activity presents any unrecognized hazard or excessive exposure that would cause harm to employees, students, or the surrounding community.
3. Investigate all incidents that result in personal injury, illness, or property damage and identify causative factors and develop appropriate corrective actions to eliminate or reduce recurrence.
4. Provide professional and technical advice on applicable safety codes and practices in construction of new and modification of existing buildings, facilities or other structures as deemed appropriate.

5. Develop new or improve existing policies and procedures related to safety and health issues.
6. Identify and develop education and awareness programs for new and existing personnel.
7. Manage all Workers' Compensation claims and work with the Public Employee Claims Division and related medical community to ensure that all employees are provided proper medical treatment when a work-related injury or illness occurs.

## ***1.2. Administration, Deans, and Department Heads***

It is the responsibility of each college/school and administrative department to conduct its operations in accordance with all-applicable laws and regulations, and to implement the University's safety and health policies.

### **1.2.1. Duties and Responsibilities**

With the professional guidance and assistance of the Environmental Health and Safety Department, these responsibilities include, but are not limited to:

1. Maintain and ensure compliance with all rules, procedures and programs as established by the Environmental Health and Safety Department that are applicable to their work areas.
2. Identify facilities and/or equipment that present a risk to safety and health and implement the appropriate corrective action(s). If the appropriate corrective action requires the replacement, upgrade, or addition of new equipment or facilities, the Dean/Department Head shall work with Administration to appropriate funds and resources.
3. Ensure that all administrative staff, supervisors, and departmental personnel are properly informed of and fully understand all University and departmental safety rules and procedures. All new employees are required to complete new employee orientation. In conjunction to that supervisors should ensure that departmental safety orientations are completed with all employees. This should include the location of the MSDS Book, personal protective equipment to be worn, location of fire extinguishers and pull stations in the employee's work area and specialized safety training that may be departmental specific (i.e. blood borne pathogens, hazardous material training, confined space training, etc.). Departmental specific training can be obtained by calling the Environmental Health and Safety Department. See **Appendix A** for a list of training available.



4. Deans and Department Heads shall work with administration to allocate the appropriate funds and resources to provide the necessary safety equipment, protective devices and tools that departmental personnel need to perform their jobs safely and effectively.
5. Ensure that all accidents resulting in or having the potential to result in any loss due to injuries, illnesses, and/or property damage are reported to the Environmental Health and Safety Department, utilizing the Accident Report Form found in Appendix B of this manual, and that appropriate corrective actions are implemented.

### **1.3. University Safety Committee**

The University Safety Committee was established to serve as the primary advisory committee to the University Safety Supervisor in all areas related to the administration of the overall Safety Program for Arkansas State University. Membership of the committee shall be as representative as possible of the total University community.

#### **1.3.1. Duties and Responsibilities**

The responsibilities of the University Safety Committee shall be to:

1. Increase the understanding and awareness of all employees in relation to safety and health hazards associated with their jobs, which will enable employees to recognize hazardous or dangerous conditions.
2. Review, evaluate and approve proposed University safety policies and programs.
3. Serve as a facilitator between administration, faculty and employees with respect to safety issues and concerns.
4. Review all incidents that result in personal injury, illness or property damage to identify causative factors and recommend appropriate corrective actions to eliminate or reduce recurrence.
5. Serve as a central forum for discussing and developing recommendations to eliminate or reduce potential hazards at the University.
6. Review findings that come from external inspections and audits, and assist the departmental units in implementing corrective actions.

### **1.4. Supervisors**

Supervisors are directly responsible for the instruction of all personnel under their supervision in regard to proper procedures and safe methods to be utilized in

performing assigned activities, for taking appropriate corrective actions to eliminate hazardous conditions and or practices necessary to prevent accidents.

#### **1.4.1. Duties and Responsibilities**

Specific responsibilities under the Occupational Safety Program include, but are not limited to:

1. At all times enforce the rules and procedures established under the Occupational Safety Program.
2. Shall not permit safety or health to be compromised for any reason regardless of productivity, time limitations or lack of available resources or funds.
3. Develop and implement safe standard operating procedures and departmental safety rules for all job tasks or activities.
4. Ensure that all personnel under their supervision are properly trained on and fully understand the rules and procedures established under the Occupational Safety Program and or specific departmental procedures.
5. Provide personnel with needed personal protective equipment, safety devices and/or proper tools, and ensure that personnel can demonstrate the proper use and limitations of the equipment assigned to them.
6. Ensure that all work areas are inspected at least monthly for hazardous conditions or unsafe practices (See **Appendix B** Workplace Audit/Inspection Report) and work with the Environmental Health and Safety Department to identify the appropriate corrective actions necessary to minimize or eliminate the potential hazard sources.
7. Report all accidents/incidents promptly to the appropriate management personnel and the Environmental Health and Safety Department by completing the Accident Report Form found in Appendix B of this manual.
8. Ensure that any injured or ill personnel receive prompt medical treatment (see Section 21 for Medical Treatment Guidelines). All minor work related injuries should be treated with a first aid kit or at the Student Health Center.
9. Accident records and overall safety performance should be included as part of the performance review for each individual under your supervision.
10. Motivate interest in health and safety by commending and recognizing personnel who maintain a safe work environment and accident-free work record, or who contribute ideas or practices for continuous improvement of the safety program.

11. Faculty members shall ensure that all students are properly informed of all applicable safety rules and procedures specific to their academic tasks or activities.
12. Faculty members shall ensure that all students are properly trained to use all equipment and tools required to perform their assigned tasks and/or activities. Provide periodic observation and evaluation of the students required skills and implement appropriate corrective action or counseling measures when needed.

### **1.5. University Employee's**

Each employee is to place health and safety requirements as first importance in the performance of job duties for Arkansas State University. All University employees, including full-time and part-time faculty, staff and student workers, shall comply with the rules and procedures established under the Occupational Safety Program and any and all departmental rules and procedures which do not conflict or compromise with the intent of the overall University safety program.

Failure to comply with or enforce health and safety rules and regulations may result in disciplinary action up to and including dismissal. Violation of work rules is a job performance issue and is addressed through the job performance evaluation.

#### **1.5.1. Duties and Responsibilities**

Specific responsibilities include, but are not limited to:

1. No employee shall perform any task or activity that is considered hazardous, without requesting and obtaining assistance from their supervisor as to the proper safety procedures and controls. Safety and health related problems or disputes that cannot be settled at either the supervisor or department level shall be referred to the Environmental Health and Safety Department for final resolution.
2. No employee shall perform any task or activity that compromises and/or violates any rules and/or procedures established under the Occupational Safety Program, any departmental rules and/or procedures, or conflicts with any regulatory standard and/or guideline.
3. Report any unsafe conditions, practices or equipment by completing the Unsafe Condition Report Form found in Appendix B of this manual. This report must be given to your manager/supervisor and a copy must be forwarded to the Environmental Health and Safety Department whenever deficiencies are observed.
4. Immediately report to your supervisor all accidents resulting in or having the potential to result in injury, illness, or property damage. (See Section 21 Work Related Injuries). Assist in obtaining prompt medical attention for any

co-worker who is injured or becomes ill.

5. Understand and comply with all University and departmental safety instructions, when performing assigned tasks or activities. Contact your department head or the Environmental Health and Safety Department should you need further clarification.
6. Employees shall not use, store or handle hazardous chemicals or materials without receiving proper training. Training can be obtained by contacting the Environmental Health and Safety Department.
7. Submit to your supervisor recommendations for ways to continually improve the Occupational Safety Program and/or departmental procedures.

### ***1.6. Departmental Safety Committee***

All departments are encouraged to develop a safety committee. The function of these committees should be to identify and control specific hazards and operations that are unique to each operating unit. The director or department head shall appoint membership to departmental safety committees. A representative from the Environmental Health and Safety Department will be available to provide advice and consultation.

#### ***1.6.1. Duties and Responsibilities***

The activities and scope of the departmental safety committees should include:

1. Serve as a central forum for discussing and developing recommendations to eliminate or reduce potential hazards within the operating unit.
2. Review findings that come from internal and external inspections and audits, and make recommendations to the department's management for corrective actions.
3. Develop new or improve existing departmental operating procedures and rules related to safety and health.
4. Assist the department's management in identifying and developing awareness programs for new and existing personnel.

### ***1.7. Responsibilities of Off-Campus Facilities and Organizations***

All University facilities and organizations located off the main campus are an integral part of the Total University community. These facilities and organizations shall comply with the same responsibilities related to safety and health issues as their counterparts located at the main campus. Each facility and organization shall adopt

all applicable rules and regulations as established under the Occupational Safety Program and shall develop site or operation specific procedures and rules as necessary for their particular activities.

### **1.8. Contractor Compliance**

Contracting firms performing work on University property shall comply with applicable occupational safety and health standards. The Associate Vice Chancellor for Facilities and the Construction Coordinator shall ensure compliance by firms performing construction, renovation, and other building and grounds repair/maintenance work. The Purchasing Agent and Department/Activity Head(s) concerned shall ensure compliance by firms performing other types of contractual services.

## **2. UNIVERSITY SAFETY RULES**

The following rules apply to all employees at Arkansas State University. Each department may have additional rules and procedures that address specific hazards and/or conditions that may be unique to those operations. Your supervisor is responsible for reviewing these rules and/or procedures with you at the time of your initial assignment to the department.

### **2.1. General Safety Rules**

1. Report any unsafe conditions, practices or equipment by completing the Unsafe Condition Report Form which can be found in Appendix B. A copy of the report must be given to your manager/supervisor and a copy must be forwarded to the Environmental Health and Safety Department whenever deficiencies are observed.
2. Be aware of all potential hazards that exist in your work area. Know your responsibilities regarding reporting and handling emergencies.
3. Do not remove, alter, or make inoperable any safety device or feature on equipment. If the safety devices on tools you are using have been tampered with, immediately call this to your supervisor's attention. Tool's in which safety devices are broken, damaged or missing shall be taken out of service IMMEDIATELY.
4. Know when safety devices, equipment and procedures are required and use them. Every supervisor should complete a job specific departmental safety orientation.
5. Read and observe all warning signs. Do not remove or deface any warning sign that has been posted in your work area.

6. Horseplay and practical jokes are prohibited at the work place. Walk – do not run, except when an emergency warrants it.
7. Walk up or down stairs one step at a time and always use the handrail for support.
8. Do not walk or stand under a suspended load. When operating a lifting device, it is your responsibility to enforce this rule.
9. Use designated aisles and walkways at all times. Do not take short cuts through roped-off areas; work area, across ditches or over rough ground.
10. Drug and alcohol use on the job is prohibited. If you are taking a prescription medication, which may affect your ability to work or operate equipment or machinery, notify your supervisor.
11. Smoking is prohibited in all University buildings and State Vehicles.

## ***2.2. Housekeeping Requirements***

1. Keep aisles and walkways clear and usable at all times. Do not block or store within 36 inches of doors, equipment, electrical panels or fire extinguishers.
2. Keep desk and file drawers and cabinet and locker doors closed when not in use.
3. Clean up spilled, non-hazardous material (liquid or solid) properly, promptly and completely. If hazardous material is involved, notify your supervisor or contact the Environmental Health and Safety Department.
4. Keep all floor surfaces clean and dry. “Caution” or “Wet Floor” signs shall be posted when floors are wet.
5. Remove and properly dispose of all excess and scrap material upon job completion.
6. Oil and/or solvent soaked rags shall be properly stored or disposed of in appropriate fireproof containers.
7. Do not stockpile supplies of potentially hazardous material (such as solvents, chemicals or paints). Be alert to the compatibility of materials being stored together.
8. If your building has a fire sprinkler system, do not store materials within 18 inches of the ceiling.
9. Unauthorized persons shall not tamper with electrical fuse boxes, alter existing

wiring, or install new electrical wiring.

### **3. FIRE PREVENTION AND SAFETY**

Fire protection services are provided by the local fire departments. The Jonesboro Fire Department annually inspects all buildings on each campus to ensure they are free of fire hazards. If a fire or explosion occurs in your presence, activate the building evacuation alarm and call the University Police Department at extension 2093 or call (9-9-1-1) which will notify the Jonesboro Fire Department. The University Police Department will also report each fire to the Environmental Health and Safety Department.

Every building is provided with exits sufficient to permit the prompt escape of occupants in case of a fire or other emergency. Exits are marked by visible, illuminated EXIT signs. Keep exit doors and signs clear of obstructions and maintain the minimum required width of 44 inches of access to exit doors. The required exit access may be more than 44 inches depending on the occupant load and the configuration of the space. Enclosed stairways provide safe passage to the outside in the event of an emergency. Keep stair doors closed to prevent the spread of fire and smoke and keep stairwells clear of storage.

Most campus buildings are equipped with a fire alarm that can be activated by pull stations, smoke detectors and sprinklers. Keep these devices free of obstructions. When activated, the alarm sounds throughout the building to initiate evacuation of building occupants. Sprinklers should have 18 inches of space beneath the deflector in order to function properly. Fire alarm systems at Arkansas State University are tested semi-annually by University electricians and annually by an outside contractor. Fire extinguishers are inspected on a monthly basis by University Personnel and annually by an outside contractor.

#### **3.1. Fire Prevention Measures**

Electricity is found in almost every corner of campus and is a common ignition source in campus fires. Make sure that the electrical equipment and appliances in your area are used according to the manufacturer recommendations. The use of makeshift electrical equipment is not permitted except in experimental laboratories when its use is crucial to the research or work being conducted and the lab personnel are qualified. All circuits should have overcurrent protection. Whenever a damaged appliance or power cord is found, it should be taken out of service and tagged immediately, until a properly trained technician can repair it.

***Note: When removing a piece of equipment from service always place a tag that states “DO NOT OPERATE – UNTIL REPAIRED”.***

Flammable liquids create a severe fire and explosion hazard. Flammables should be kept in approved, sealed containers. These containers should be stored in a flammable liquid storage cabinet or approved storage rooms. Refrigerators used for

flammable storage should be manufactured for that purpose and labeled as such on the front of the door. Take out from storage only the amount needed for the day. Eliminate sources of ignition when using flammables, including static electricity, friction, and heat from an oven.

Open flames, whether in a laboratory, kitchen, or shop are, should always be attended. Keep open flames away from combustible and flammable materials. Good housekeeping is always an important safety measure. Discard combustible waste as soon as possible. Accumulations of paper products are a fire hazard.

### **3.2. Emergency Procedures**

1. **DO NOT** use the elevators. Remain calm and assist in the evacuation procedures.
2. In case of a fire or a false fire alarm, all personnel in the building shall evacuate the building. Personnel must remain outside the building until the fire department or the University Police Department gives permission for reentry to the building. Any employee who fails to evacuate a building during a fire, false fire alarm or fire drill shall be subject to disciplinary action.
3. Persons noting potential fire hazards should report the circumstances to Environmental Health and Safety for investigation, and recommendation of corrective action.
4. Fire safety equipment, such as extinguishers, hoses and alarm systems shall be used for the designed purpose only. Contact the Environmental Health and Safety Department for training in this area.
5. Empty or damaged fire extinguishers should be reported to the Physical Plant or the Environmental Health and Safety Department for immediate replacement.
6. Fire drills should be conducted in each building at least annually. The Environmental Health and Safety Department shall maintain a record of these fire drills.
7. Fire Evacuation Plans shall be posted in all buildings.
8. If it is necessary to turn off or disconnect a fire water line, sprinkler system, standpipe system, fire hydrant, or fire alarm system, it shall be the responsibility of the Physical Plant to notify the Jonesboro Fire Department and the University Police Department before performing work on water lines, sprinkler systems or hydrants. It shall also be the responsibility of the Facilities Management Department to notify the Fire Department and the University Police Department after the fire water line; sprinkler system or hydrant has been returned to service.
9. Supervisors and classroom/laboratory instructors shall ensure that good



housekeeping procedures are always followed. They shall initiate immediate action to alleviate fire hazards or other conditions not meeting fire prevention standards.

### ***3.3. Training for Fire Safety***

The Environmental Health and Safety Department will provide fire safety and evacuation training to campus groups upon request.

## **4. LIFTING AND CARRYING**

Preventing back injuries is a major workplace safety challenge. According to the Bureau of Labor Statistics (BLS), more than one million workers suffer back injuries each year, and back injuries account for one of every five workplace injuries or illnesses.

Material handling can be a source of occupational injuries whether the work is done manually or with mechanical assistance. Jobs that involve manual, mechanical, or repetitive handling present the highest risk of injury.

Material handling requires careful consideration of many factors including the area of ergonomics. Every job that involves manual, mechanical or repetitive handling should have a job analysis performed to determine how worker injury can be minimized.

### ***4.1. Rules for Lifting and Carrying***

Most back injuries that occur on the job are a result of poor lifting technique. Lifting and carrying objects should be designed out of jobs whenever possible. When lifting cannot be avoided, employees should get assistance with heavy and awkward objects. Following the procedures listed below can reduce the risk of injury:

1. Do not attempt to carry an object or load, which is more than you can carry safely; get help from a co-worker or use a lifting/moving device such as a dolly or pallet jack.
2. Do not try to lift heavy objects higher than waist level.
3. Before lifting and carrying objects, you must first check the route of travel for distance, floor conditions and obstructions. Always maintain a clear view over the load.
4. Make sure the object is clean and free of sharp edges or objects that could cause cuts or punctures. Wipe any grease, oil, water and or dirt off the load before lifting.
5. When lifting, keep your back straight and knees bent. Lift with your leg muscles in a gradual and smooth motion. Avoid jerking or twisting and keep the load

close to your body. Reverse the procedures when setting the object down.

6. When two or more people are handling the same object/load, one should be designated to provide directions. Warn each other if you start to lose your grip or cannot control the load.
7. Supervisors are responsible for making the appropriate material handling devices available to their employees and ensuring that the proper devices are used and maintained.

#### ***4.2. Training for Manual Material Handling***

Each department that has employees who will perform material handling operations whether manual or mechanical must contact the Environmental Health and Safety Department to schedule specialized training for material handling. This will include:

- Training employees to utilize techniques that place minimum stress on the lower back.
- Physical conditioning or stretching programs to reduce the risk of muscle strain.
- Adjusting the height of a pallet or shelf. Lifting which occurs below knee height or above shoulder height is more strenuous than lifting between these lines.
- Employees involved in the following material handling operations must receive Certified Training from the Environmental Health and Safety Department PRIOR TO operating the equipment:
  - Powered Industrial Trucks
  - Cranes
  - Powered Platforms

## **5. LADDERS, SCAFFOLDS AND WORK PLATFORMS**

Prior to beginning work in any area or on any device such as ladders, scaffolds or work platforms, it is the policy of Arkansas State University to follow the listed guidelines below in an effort to reduce the likelihood of fall accidents

### ***5.1. Ladders, Scaffolds and Work Platform Guidelines***

1. Do not use a chair, box, carton, shelf or anything else as a ladder. Use only approved ladders, step stools, scaffolds or work platforms for reaching heights.
2. Inspect the ladder, stool, scaffold, etc., prior to each use to ensure that they are in serviceable condition. Remove from service and tag any defective device and report it to your supervisor. Do not try to repair any damaged ladders.
3. Be sure that extension ladders are tall enough to do the job safely. The top of the ladder should extend at least three (3) feet above the top support point.

4. When using a stepladder, make sure that it is fully spread and locked. Check for unsafe hinges as well as damaged steps and uprights. Never stand on either of the top two- (2) steps.
5. Fiberglass or other insulated ladders, rated for electrical work, are required when working on or around electrical equipment.
6. Do not climb a ladder that is occupied by someone else, unless it is designed and certified for such use by the manufacturer.
7. When climbing or descending, face the ladder and hold onto each rung. Whenever possible, another person should steady the ladder for the climber.
8. No attempt should be made to reach beyond a normal arm's length while standing on the ladder, especially to the side.
9. Extension ladders should be secured at the top and bottom to prevent the ladder from falling.
10. Scaffolds and any related ropes and lines shall be in good repair and equipped with operable safety brakes. Inspect scaffolds each time they are erected and before each use.
11. Move, if possible, or protect persons, furniture, equipment or machinery, under a scaffold.
12. Where a scaffold or work platform is above six (6) feet high, guardrails and toe boards must be installed on any open side or end.
13. Scaffolds shall not be moved horizontally while in use. Do not work on scaffolds or ladders during storm or high wind.
14. Employees working at elevations of six (6) feet or higher shall wear an approved safety harness attached to a lifeline. The lifeline shall be attached to a structurally sound part of the building or to securely rigged lines. Do not attach the lifeline to the scaffold or its supports.
15. Work platforms or man-lifts that are equipped with out-riggers must be properly positioned and secured before work begins.

## **6. MACHINE SAFEGUARDING**

Crushed hands and arms, severed fingers, blindness, etc. are part of a list of possible machinery-related injuries. A good rule to remember is that any machine part, function, or process, which may cause injury, must be safeguarded. When the operation of a

machine or accidental contact with it can injure the operator or others in the vicinity, the hazards must be either controlled or eliminated.

### **6.1. General Rules**

1. One or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by point of operation, ingoing nip points, rotating parts, flying chips and sparks. Examples of guarding methods are barrier guards, two-hand tripping devices, electronic safety devices, etc. If guards become broken or damaged, the machine/equipment must be taken out of service immediately and tagged.
2. Guards shall be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not possible. The guard shall be such that it does not offer an accident hazards in itself.
3. Whenever engineering controls are not available or are not fully capable of protecting the employee, operators must wear personal protective equipment.

### **6.2. Hand and Power Tools**

Hand and power tools enable employees to apply additional force and energy to accomplish a task. These tools improve efficiency and make better products. Because of the increased force of hand and power tools, the objective of safety with these tools is to themselves and others. Disabilities resulting from misuse of tools or using damaged tools include loss of eyes and vision; puncture wounds from flying chips; severed fingers, tendons, and arteries; broken bones; contusions; infections from puncture wounds; ergonomic stress, as well as many other injuries.

1. Supervisor and employees equally share the responsibility for ensuring that equipment and tools are safe.
2. Any tool that is malfunctioning shall be immediately removed from service and tagged.
3. Only appropriately trained employees shall operate tools and machinery. The supervisor is responsible for ensuring that employees have been properly trained.
4. All tools and equipment are to be kept in a clean and repaired condition. Keep all tools properly lubricated and make sure all cutting tools are sharp.
5. Use the right tool for the job and keep it in a safe place.
6. Do not carry any tool or piece of equipment by the cord or yank it to disconnect it from the receptacle.

7. Secure your work by using clamps or a vise.
8. When sawing, never reach under the material being cut.
9. Never exceed the manufacturer's recommended speed (RPM) on any rotary equipment.
10. All rotary operating machines and all pinch points must be protected by a proper guard or shield.
11. Electric tools shall be grounded or double insulated in an approved manner and control switches shall be placed at a readily accessible point.
12. Buffers, floor machines and wet-dry vacuums are to be grounded and the cords shall be kept clear of water.
13. When using pneumatic-driven equipment (e.g., nail guns, etc.), extreme caution shall be used. Only properly trained employees shall use this type of equipment.
14. Air powered (pneumatic) tools shall be secured to the hose in such a manner as to prevent disconnection, and the manufacturer's recommended safe operating pressure shall not be exceeded.
15. Tractors or other equipment with power take-off shafts shall be guarded. This equipment shall be shut off before the operator dismounts to make any repairs or adjustments.
16. Abrasive wheel and stand grinders shall be provided with safety guards, which cover the spindle ends, nut and flange projections, and are strong enough to withstand the effects of a bursting wheel. If guards become broken or damaged the equipment must be removed from service and tagged until it can be repaired.
17. Floor and bench mounted grinders shall be equipped with a rigid work rest adjusted to a clearance not to exceed 1/8 inch between the rest and the wheel surface. Should the work rest become broken the grinder will be taken out of service and tagged until it can be repaired.
18. Abrasive wheels shall be closely inspected and ring-tested before mounting to ensure that they are free from defects. Abrasive wheels should be inspected daily for cracks.
19. Before any repairs or adjustments are made to equipment or machinery, the power/energy source shall be properly disconnected, locked and tagged out-of-service in accordance with the University's Control of Hazardous Energy Program contact the Environmental Health and Safety Department for a copy of

this program.

## **7. ELECTRICAL SAFETY**

Electricity is one of the most commonly encountered hazards in any facility. Therefore, safety related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized.

### ***7.1. General Electrical Safety***

1. Coffee pots, hot plates, electric irons and special heating equipment shall only be used when plugged directly into a wall outlet. No extension cord may be used for these types of appliances.
2. All equipment must have grounded three-prong plugs.
3. Extension cords are for temporary use only and must be properly sized or rated for the tool or equipment being used.
4. Always use grounded electrical outlets and do not overload them. Never remove the grounding post from a three-prong plug to make it fit into a two plug outlet.
5. If additional electrical outlets are needed in a work area, only power strips equipped with a circuit breaker for overload protection shall be used.
6. Do not use any extension cords that are frayed or have been spliced together.
7. All electrical cords and cables shall be properly secured and located so as not to present a tripping hazard.
8. Extension cords that are used outdoors and/or near water sources shall be equipped with a ground-fault circuit interrupter (GFCI).
9. Any electrical receptacle located within six (6) feet of a water source (e.g., sink, water fountain, etc.) shall be protected by a GFCI.
10. Proper clearance (36 inches) shall be maintained in front of all electrical panels, disconnect switches, and transformers. Electrical/Mechanical rooms shall not be used for storage and should be secured at all times.
11. Before any work or repair is conducted on an electrical source, the power/energy source shall be properly disconnected, locked and tagged out-of-service in accordance with the University's Control of Hazardous Energy. A copy of this program may be obtained by calling the Environmental Health

and Safety Department.

## **7.2. Lockout/Tagout Procedures**

Employees who service or maintain machines or equipment may be at risk due to the sudden start-up or release of stored energy from this equipment. The Environmental Health and Safety Department provides training for the implementation of this program to all campus employees authorized to do maintenance work on hazardous machinery. Supervisors of employees who perform maintenance should call the Environmental Health and Safety Department to arrange for training.

The following procedures will be followed when working in lockout/tagout situations:

1. Determine the types of stored energy of the equipment to be serviced;
2. Shut down machine;
3. Shutoff all energy supplies;
4. Apply locks and tags;
5. Release stored energy;
6. Verify that machine cannot be turned on;
7. Perform the service;
8. Inspect the work area for hazards;
9. Return machine to service.

## **7.3. Electrical Safety Training Requirements**

The training requirements apply to employees who face a risk of electrical shock that is not reduced to a safe level by the electrical installation requirements. Employees in occupations facing a higher than normal risk of electrical accident are required to be trained. Additionally, other employees who may reasonably be expected to face comparable risk of injury due to electric shock or other electrical hazards must also be trained. Employees shall be trained in, and become familiar with, the safety related work practices as outlined in the University's Control of Hazardous Energy (Lockout/Tagout) Program.

# **8. TRENCHING, SHORING AND EXCAVATION**

Excavation and trenching are extremely hazardous operations that expose workers to the possibility of serious injury or death. The greatest hazard associated with trenching is the cave-in of the surrounding soil on workers in the trench, the result often being fatal. Other hazards involved in trenching include falls, confined spaces, and exposure to underground utilities such as gas, steam and electricity. Employees involved in excavation operations should be knowledgeable about how to minimize these hazards.

### ***8.1. Trenching, Shoring and Excavation Guidelines***

1. Before opening any excavation, the area shall be properly reviewed with all available sources including non-University sources. The Facilities Management Department and Arkansas One Call (1-800-482-8998) must be notified 48 hours prior to opening any excavation to determine if there are any underground utility installations, that could present a hazard and/or be damaged. All excavation areas must be marked in WHITE.
2. The walls and faces of trenches five (5) feet or more deep and all excavations, in which employees are exposed to danger from moving ground or cave-in, shall be guarded by either a shoring system, sloping the ground, or a combination of both.
3. All open excavations shall be properly barricaded and marked with appropriate warning signs or devices.
4. Excavated material must be shored or retained two (2) feet or more from the edge of the excavation.
5. Trenches of four (4) feet deep or more shall have an adequate means of exit such as ladders or steps, located so as to require no more than twenty-five (25) feet of lateral travel.
6. The job supervisor shall make daily inspections of excavations. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary precautions have been taken to safeguard the employees.
7. Workers shall wear all required personal protective equipment including hardhats, safety footwear, gloves, eye protection, hearing protection and fall protection devices as needed.

### ***8.2. Training for Trenching, Shoring and Excavation***

Employees assigned to perform trenching, shoring and excavation duties will be properly trained prior to performing these functions. Training can be obtained through the Environmental Health and Safety Department.

## **9. RESPIRATORY PROTECTION**

A respirator is a personal protective device used to protect the wearer from inhalation of harmful levels of airborne contaminants. The use of respirators is acceptable only when engineering or work practice controls (e.g., local exhaust ventilation) are inadequate or not feasible, or while these controls are being designed or constructed. Respirators must be carefully selected, properly fitted, regularly inspected, cleaned, and repaired when broken. Wearers must be medically evaluated for respirator use and trained in the



appropriate use, care, maintenance and limitations of respiratory protective devices. Employees, whose positions require the use of a respirator must contact the Environmental Health and Safety Department to schedule a medical evaluation, respirator fit test and training. Work area environments must be periodically evaluated to determine the appropriate level of respiratory protection necessary.

### ***9.1. Respirator Usage Requirements***

1. Respirator users shall be evaluated by a licensed health care provider to determine if they are physically able to perform work while using a respirator.
2. Respirators shall be selected based upon the contaminant hazards presented to the wearer.
3. Respirators shall be approved by the National Institute for Occupational Safety and Health (NIOSH) for the contaminant(s) and situation(s) to which the wearer will be exposed.
4. All negative pressure respirators shall be fit-tested at least annually (semi-annually if required by more restrictive substance-specific standards, i.e., asbestos, and lead) and shall be fit-checked by the wearer before each use.
5. Respirators shall be maintained and repaired in accordance with manufacturers' specifications. Storage shall be appropriate to protect against damage caused by dust, sunlight, temperature extremes, moisture, chemicals and physical/malformation conditions.

### ***9.2. Respirator Training***

The Environmental Health and Safety Department shall provide training to all users of respiratory protective equipment to include:

1. Selection of respirators;
2. Inspection, maintenance, storage and cleaning of respirators;
3. Respirator limitations and emergency procedures;
4. Methods of donning, adjusting and fit-checking (hands-on);
5. Respiratory hazards.

### ***9.3. Recordkeeping***

Written records shall be maintained in the Environmental Health and Safety Department for training, fit-testing, and medical examinations for at least 30 years following termination of employment for any individual wearing a respirator.

## **10. FALL PROTECTION**

Fall protection is a term that can be defined as any means used to protect workers from

falls during work in areas where fall hazards exist. Such areas include stairways, ladders, raised platforms, roofs, etc. In such areas, engineering or design measures are most frequently used to reduce the fall hazards. Occasionally further measures such as fall protection devices like lanyards and belts or harnesses must be used to reduce the risk of falls. Below is a list of general guidelines for preventing employees from falling off, onto or through working levels and protect employees from falling objects.

### **10.1. Fall Protection Guidelines**

The requirements shown below reduce the potential for employee injury related to falling.

1. Stairway/Ladderway floor openings must be guarded with a railing.
2. All floor openings into which a person could accidentally walk must be appropriately guarded or covered.
3. Open sided floors or platforms four (4) feet or more above adjacent surfaces must be appropriately guarded.
4. Ladders and scaffolding must be designed, constructed, and used in an appropriate manner.
5. Elevator doors must not open between floors.
6. Wall openings must be appropriately guarded.
7. Employees must be protected from hazards associated with “unprotected” roof surfaces.
8. Safety harnesses, lifelines, lanyards, and safety nets used for fall protection shall be designed, constructed, and used in compliance with applicable regulations.
9. Every floor, working place and passageway must be kept dry and free of obstructions.

### **10.2. Fall Protection Training**

Under no circumstances shall an employee work in areas of high fall hazards, do work requiring fall protection devices, or use fall protection devices until he/she has successfully completed the Fall Protection Training.

### **10.3. Inspections**

Equipment associated with fall protection (ropes, harness, ladders, scaffolding, etc.) must be inspected frequently and removed from use if damaged or defective.

Walking and working surfaces must be inspected frequently to identify, correct, and plan protection for potential fall hazards.

## **11. WELDING**

Employees who perform welding operation during the course of their work are subject to specific hazards associated with this activity. Burns, eye damage and fire are the primary risks. Safe welding practices and procedures shall be followed:

### ***11.1. Welding Equipment***

Arc welding equipment shall be chosen for safe application to the work and shall be properly installed. Proper shielding and eye protection to prevent exposure to personnel from welding hazards shall be provided and used.

Take great care to assure acetylene and oxygen tanks are securely fastened to prevent their falling over or being knocked down, both on the job and during transportation. (See Section 13 for Compressed Gas Guidelines).

Use all possible ventilation when welding or soldering. Wear respirators of proper design when welding toxic material (e.g. galvanized iron) to avoid breathing harmful fumes. (See Section 9 for Respirator Guidelines).

Avoid welding in the same work area where flammables or combustibles are present.

### ***11.2. Training Requirements for Welding***

Workers designated to operate welding equipment shall have been properly instructed and qualified to operate it.

### ***11.3. Fire Prevention***

Precautions for fire prevention in areas where welding or other “hot works” is being done shall include isolating welding and cutting activities, removing fire hazards from the vicinity and providing a fire watch.

### ***11.4. Ventilation Procedures for Welding***

Mechanical ventilation shall be provided when welding or cutting:

- beryllium, cadmium, lead, zinc or mercury;
- fluxes, metal coatings or other material containing fluorine components;
- where there is less than 10,000 cubic feet per welder;
- in confined spaces.

## **12. PERSONAL PROTECTIVE EQUIPMENT**

Protective equipment, including personal protective equipment (PPE) for eyes, face, head and extremities, protective clothing, respiratory devices and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

### **12.1. *Personal Protective Equipment Guidelines***

The Environmental Health and Safety Department in conjunction with department supervisors shall conduct hazard assessments of each work area, to determine if hazards are present, or likely to be present, which necessitates the use of personal protective equipment.

1. Supervisors are responsible for furnishing each employee with appropriate PPE as identified through the hazard assessment procedure.
2. It is the employee's responsibility to use, maintain and clean the PPE furnished to them. Should the employee's PPE become broken, damaged or worn, it is the employee's responsibility to ask for a replacement. (Note: the equipment being replaced must be turned in to the supervisor)

### **12.2. *Eye and Face Protection***

1. Eye and face protection shall be provided and worn where there is the potential for injury from chemical splashes, flying particles or projectiles, and/or injurious radiant energy.
2. An eyewash and shower is required where chemical splashes are possible.
3. Eye protection equipment is available through your department. Various tasks require different eye protection, eye goggles or glasses.

### **12.3. *Head Protection***

Head protection (hard hat) shall be provided and worn when there is potential for injury from falling objects or if work is performed near exposed electrical conductors which could contact the head.

### **12.4. *Hand Protection***

Hand protection shall be provided and worn when there is a potential for injury or exposure from skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns and harmful temperature

extremes.

### **12.5. Foot Protection**

Foot protection (safety shoes) should be worn when there is a potential for injury from heavy or sharp objects falling on or rolling over the foot, or from objects piercing the sole the shoe. Slip resistant shoes should be worn in work areas where there is a potential for water.

### **12.6. Hearing Protection**

Hearing protection shall be provided and worn when the noise exposure in a work area exceeds 85 dBA (time-weighted average) over an 8-hour work period. If you feel your work area has a noise problem, contact the Environmental Health and Safety Department to conduct a noise survey.

### **12.7. Respiratory Protection**

Respiratory protection shall be provided and worn whenever there is a potential for exposure to harmful fumes, vapors, dust, etc., and local exhaust or general ventilation can not be adequately provided. Before using a respirator, an employee must be medically evaluated and certified, fit-tested and properly trained in the use, care and limitation of the respirator. No single respirator can provide protection against all contaminants. The right type of respiratory protection must be selected based on the contaminant of concern. Contact the Environmental Health and Safety Department for further information or refer to Section 9 of this manual.

### **12.8. PPE Training**

The supervisor shall ensure that each employee who is required to use PPE is properly trained. Each employee shall be trained to know at least the following:

- when PPE is necessary;
- what PPE is necessary;
- how to properly put on, take off, adjust, and wear PPE;
- the limitations of the PPE; and
- the proper care, maintenance, useful life and disposal of PPE.

### **12.9. PPE Inspections**

PPE shall be inspected, cleaned, and maintained at regular intervals so that the PPE provides the requisite protection. Should the PPE become damaged, it shall be replaced immediately.

## **13. COMPRESSED GAS CYLINDERS**

Compressed gases are used throughout the University for both academic and trades purposes. Pure gases and gas mixtures are used in research as reactants and carriers. Welding and refrigeration charging are typical industrial applications involving compressed gases.

### **13.1. Storage and Use Guidelines**

1. All cylinders (full or empty) shall be stored and secured, in an upright position at all times with a chain or strap, on the top and bottom to prevent kick-out at base of cylinder, except if necessary for short periods of time (i.e. when the cylinders are being hoisted or carried).
2. All compressed gas cylinders must be clearly marked with the correct chemical name.
3. The valve protection cap shall be in place when cylinders are transported, moved or stored.
4. Cylinder valves shall be closed when work is completed and when cylinders are empty or are moved.
5. Cylinders shall be marked/tagged to indicate the cylinder usage status (e.g., FULL, IN USE, or EMPTY).
6. Cylinders containing flammable gases shall be kept at a safe distance or shielded from welding or cutting operations. Cylinders shall be placed where they cannot come into contact with an electrical circuit.
7. A distance of at least twenty (20) feet shall separate cylinders containing flammable materials from oxidizers.
8. Empty re-usable cylinders shall be returned to the original gas supplier. Empty cylinders shall not be modified for other uses.

### **13.2. Compressed Gas Cylinder Training**

Individuals using compressed gases must be trained in the safe use of the material and pressurized systems. Primary responsibility for specific operations training is with the employee's supervisor. The Environmental Health and Safety Department may be consulted as necessary.

## **14. CONFINED SPACES**

Regulations require that employees be protected from hazards associated with entry into confined spaces. Confined Spaces are spaces large enough to be entered to perform work, have limited means for entry/exit, and are not designed for continuous employee

occupancy. Examples are sanitary sewer manholes and underground electrical vaults. Confined spaces may be dangerous to workers because of many different conditions. These may include:

- Atmospheric hazards: Oxygen enrichment or deficiency, flammable/explosive vapors or gases, or toxic vapors and gases.
- Engulfment hazards: Materials within the space that could engulf entrant(s)
- Internal configuration hazards: Spaces whose internal configuration (inwardly converging walls) could trap or asphyxiate entrant(s).

#### **14.1. Training**

Employees associated with entry into confined spaces are required to be trained and properly equipped for safe entry prior to working in these areas. The Environmental Health and Safety Department will conduct training for employees on an as needed basis.

#### **14.2. Supervisor Responsibilities**

1. Ensure that all employees receive proper training *prior to* working in confined spaces.
2. Notify the Safety Supervisor prior to performing work in a confined space and obtain a permit to work in those areas.
3. Monitor the work site to ensure that the University Confined Space Program is followed and safe work practices are observed at all times.

### **15. HEAT RELATED INJURIES**

In Arkansas, workers face heat stress situations during hot weather months. Exposure to the heat can be deadly or can result in permanent damage to internal organs such as the kidneys. The following information is designed to inform employees about the hazards of working outdoors and how to protect your self from those hazards.

#### **15.1. Heat Stress**

Heat stress can occur anywhere within the University System under adverse heat conditions. Situations which might present cause for concern include athletic activities, strenuous outdoor physical activities and indoor working conditions in non-air-conditioned spaces. Protective clothing, required by the activity, also requires consideration of heat conditions.

Normally, our employees and students who are exposed to seasonal temperature variations become accustomed to the higher temperatures gradually as the weather warms up. This natural acclimatization enables these individuals to perform physical activities under hot conditions with minimal adverse effects. Unseasonably high temperatures of heat waves, however, may stress individuals who might otherwise be able to handle the hotter temperatures under normal conditions. Likewise, persons

who are not used to performing physical activities under high heat conditions may suffer ill effects from the heat if not introduced into these activities gradually. It is important; therefore, that supervisors and instructors be trained in the recognition of potential heat stress conditions, the symptoms and proper first aid treatment for heat related illnesses. The Environmental Health and Safety Department can provide the necessary training upon request. Failure to provide immediate, proper treatment to a heat stress illness may result in the death of the stricken individual.

## **16. ACCUTE HEAT DISORDERS (ILLNESSES)**

### **16.1. *Heat Rash***

A reddening of the skin caused by a buildup of sweat in the skin due to clogged sweat pores. Generally, this condition is caused by poor personal hygiene and can be alleviated by washing the affected areas regularly and the application of drying lotions to the skin.

### **16.2. *Transient Heat Fatigue***

Marked by impaired mental or physical performance, possible nausea and a fatigued feeling. Although there is no treatment indicted for this condition, the discomfort and physiologic strain can be reduced by acclimatization and training to increase skill levels for the tasks being performed.

### **16.3. *Heat Syncope (Fainting)***

Fainting caused by insufficient blood flow to the head. Prolonged standing in heat causes blood to pool in the lower extremities. This pooling, along with the increased circulation of blood in the skin due to vasodilatation, causes a reduction in venous return to the heart. Insufficient blood is pumped through the circulatory system and the brain does not receive adequate oxygen. By fainting, the head is brought lower to the level of the feet, and circulation to the brain is restored. Persons who have fainted respond well to lying down in a cool area (shade, air conditioning, etc.). Recovery is normally prompt and complete. Preventative measures include acclimatization and intermittent activity to aid in the circulation of the blood in the lower portions of the body.

### **16.4. *Heat Cramps***

Cramping of voluntary (skeletal) and involuntary (abdominal) muscles. Caused by the loss of salt (electrolytes) due to heavy sweating and by drinking large volumes of water without replacing these salts, this condition is treated by administering salted liquids by mouth. Prevention consists mainly of drinking electrolytic beverages such as Gatorade to replace needed salts as well as fluids. Salt Tablets are NO LONGER recommended due to the hazards of hypertension (high blood pressure).



## **16.5. Heat Exhaustion**

Fatigue, nausea and dizziness are all symptoms of heat exhaustion. The individual is usually moist and clammy with a pale appearance. This condition is brought on by the depletion of the body's fluid content by sweating; accompanied by strenuous activity to the point that blood circulation is adversely affected. This dehydration along with the competition for blood between the skin, for cooling, and the muscles, for oxygen, results in a circulatory strain, which can be compared to shock. Treatment consists of moving the individual to a cooler location, having him/her lie down and drink large volumes of liquids. After a period of rest and the intake of adequate fluids, the individual will appear to have recovered; however, return to activities in hot conditions should be accomplished gradually, under close supervision, as the individual may be more susceptible to heat stress as a result of the occurrence of heat exhaustion. Prevention consist of drinking adequate amounts of suitable liquids regularly over the period of heat exposure, beyond that called for by the thirst mechanism, and gradually becoming acclimated to the heat.

## **16.6. Heat Stroke**

Heat stroke is a very serious medical emergency. The human body experiencing heat stroke has lost the ability to thermoregulate (maintain proper temperature) due to a fatigue and shut down of the seating mechanism. Body core temperature rises rapidly to life threatening levels. The victim slips into a coma and may die. Symptoms include hot, dry skin which may be red, mottled or cyanotic (bluish). Victims are confused, lose consciousness, convulse, become comatose and die if proper treatment is not rapidly administered. Predisposing conditions, which may lead to heat stroke, include:

- Sustained exertion in the heat when not acclimatized;
- Poor physical condition and obesity;
- Recent alcohol intake;
- Dehydration;
- Individual susceptibility; and
- Chronic cardiovascular disease.

Treatment consists of a rapid cooling of the body by immersion in chilled water with massage, wrapping the victim in wet sheets and vigorously fanning, or wiping the individual down with alcohol. It is important to avoid over-cooling and treat for shock if necessary. Call for medical assistance immediately. Heat stroke can be avoided by proper screening of individuals regarding their health and physical fitness and by gradually acclimatizing over a period of five to seven days. During particularly severe heat conditions, all participants in strenuous activities should be watched by someone trained in recognizing heat stress illnesses and their proper treatment.

## **16.7. Acclimatization**

Individuals expecting to engage in strenuous activities or work in the heat who are not used to doing so can reduce the likelihood of suffering an acute heat disorder by first undergoing an acclimatization program. Vacations, illnesses, excessive or regular alcohol use, poor physical conditions and obesity relatively affect the body's ability to acclimatize to heat. Supervisory personnel should be aware of these factors and pay particular attention to individuals fitting the above categories if heat is going to impact on their activities.

For more information regarding Heat related illnesses, you may contact the Environmental Health and Safety Department.

## **17. RADIATION SAFETY**

Radioactive materials are used in University laboratories for research purposes. Arkansas State University operates under regulations established by the Arkansas Department of Health – Division of Radiation Control and Emergency Management. The Radiation Safety Committee sets University Policy for radiation protection. The committee is established to assure compliance with all regulations regarding the use of radioactive materials and/or radiation producing devices and the conditions set forth by the license. This committee has developed the Arkansas State University “Radiation Safety Manual” which shall serve as the University's procedure regarding the use of all radioactive materials. Copies of this manual are available for review in the Biology Department, Deans Office – College of Arts and Sciences, and the Environmental Health and Safety Department. The Radiation Safety Officer also has a copy on file.

No one may use, bring, purchase or remove from the University any radioactive material without the approval of the Radiation Safety Officer or the Radiation Safety Committee. Every individual working with radioisotopes or in radiation controlled areas must be approved/authorized by the Radiation Safety Officer and/or Radiation Safety Committee and must have appropriate radiation protection training for the material being used.

### **17.1. Inspections**

In accordance with the requirements of the University Radiation Safety Manual and the University License Conditions, the Environmental Health and Safety Department will conduct periodic inspections of the Radiation Program.

## **18. BLOODBORNE PATHOGENS**

Some employees may be at risk of occupational exposure to blood and other potentially infectious materials that may contain micro-organisms that cause viruses such as Hepatitis B virus (HBV), human immunodeficiency virus (HIV), or other bloodborne viruses.

### **18.1. Definition**

Bloodborne Pathogen refers to pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to human immunodeficiency virus (HIV), which causes acquired immunodeficiency syndrome (AIDS); hepatitis B virus (HBV) which causes a potentially fatal liver disease.

### **18.2. Occupational Exposure**

Means the anticipated skin, eye, or mucous membrane contact with blood or other potentially infectious materials that may result from the performance of an employee's duties.

The following employees are considered to have occupational exposure to bloodborne pathogens:

- Custodians
- Nursing and Health Professions Workers
- University Police Officers
- Health, Physical Education and Recreation Center Staff
- Athletic Trainers
- First Responders

### **18.3. Control Measures**

An individual can be exposed or become infected when the blood or other body fluid from an infected person comes in contact with your blood. The most common ways this happens is through a puncture in the skin, absorption through nonintact skin or through the mucous membranes. Nonintact skin includes cuts, scratches, and rashes. Mucous membranes are found in the eyes, nose and mouth.

The best way to protect yourself from exposure is to use universal precautions. Universal Precautions are implemented to prevent employee contact with blood or other potentially infectious materials to reduce the risk of occupational exposure. Universal precautions is simply treating ALL blood and body fluids as if they are infected. Even if it is someone you know well, assume that there blood is dangerous to you.

Engineering and work practice controls are used to eliminate or minimize employee exposure.

Eating, drinking, smoking, applying cosmetics or lip balm, and handling contact lenses are not allowed in work areas where there is a reasonable likelihood of occupational exposure. Food and drink WILL NOT be kept in refrigerators, freezers, shelves, cabinets or on countertops or benchtops where blood or other potentially

infectious materials are present.

#### **18.4. *Clean Up of Blood Spills***

Blood spills will ONLY be cleaned up by trained employees. Should a blood spill occur in your department, contact the custodial department or the Environmental Health and Safety Department. If your hands or other skin surfaces come in contact with blood they must be washed immediately or as soon as possible. If blood is splashed into the eyes, they must be flushed with running water for fifteen minutes.

#### **18.5. *Exposure Guidelines***

Post exposure evaluation and follow-up is provided following the reporting of an employee exposure to blood or other potentially infectious material. If you have an incident where you are exposed, or think you have been exposed, you need to report the incident immediately to your supervisor and the Environmental Health and Safety Department. The Environmental Health and Safety Department will maintain all records concerning employee incidents involving blood/body fluid exposures.

### **19. CHEMICAL RIGHT-TO-KNOW**

The purpose of this law is to provide public employees access to training and information concerning hazardous chemicals in order to enable them to minimize their exposure to such chemicals and protect their health, safety and welfare.

Public employees who may be exposed to hazardous chemicals as part of their job function must be informed and have access to the Workplace Chemical List, and have access to the Material Safety Data Sheets for the chemicals on the list.

#### **19.1. *Employers' Responsibilities***

As required by the Arkansas Act 551 of 1991, Public employers such as Arkansas State University are responsible for the following as set out by law:

1. Copies of the NOTICE TO EMPLOYEES form must be posted in enough places to ensure that employees are aware of their rights.
2. Ensure that all chemicals are properly labeled.
  - (a) Existing labels on containers of hazardous chemicals are not to be removed.
  - (b) If a chemical is transferred to another container, it must also be labeled with the name and appropriate warnings, as provided by law.
  - (c) An employer is not required to label chemicals that have been transferred to a portable container by an employee when that employee is going to IMMEDIATELY use the chemical.
3. Maintain and make material safety data sheets available.

4. Compile and maintain a workplace chemical inventory list for hazardous chemicals used, generated, or stored in amounts of 55 gallons or 500 pounds or more. This list is required to be filed annually with the Arkansas Department of Labor.

### **19.2. Employee Rights**

Employees who may be exposed to hazardous chemicals are guaranteed access to the following:

1. Arkansas State University's Written Hazard Communication Program
2. Arkansas State University's Chemical Inventory List
3. Material Safety Data Sheets associated with the Chemical Inventory

Employees also have the right to receive training regarding the hazards associated with working with chemicals. Employees have the right to file a complaint against the University regarding alleged violations of the Chemical Right-To-Know Act without fear of bearing terminated.

For further information regarding hazardous chemicals in the workplace you may refer to the Arkansas State University Environmental & Chemical Compliance Manual or contact the Environmental Health and Safety Department.

## **20. OFFICE SAFETY**

Office work can pose a number of hazards to your health and safety. These hazards are dangerous because they are hidden. This section is devoted to showing you how to avoid slips, trips and falls; it will also cover fire safety and ergonomics. Most people do not generally realize that it is possible for persons working in offices to be injured or suffer a lifestyle changing accident.

### **20.1. Workstation Ergonomics**

Each working environment has its own physical challenges. What appears to be a harmless activity can have dangerous physical consequences. For instance, the simple action of using a keyboard can take a toll on your body when the work is repeated continuously and rapidly day after day. Ergonomics involves arranging the environment to fit the person. In the workplace, ergonomics helps to adapt the job to fit the person, rather than force the person to fit the job. Adapting the job to fit the worker can help reduce stress and eliminate many potential injuries and disorders associated with the overuse of muscles, bad posture, and repetitive motion. Assistance with office ergonomic design, or redesign can be obtained by contacting the Environmental Health and Safety Department.

### **20.1.1. Work Positions**

Working in awkward positions increases your chance of injuring muscles, tendons, nerves or joints. These injuries can be prevented by following these tips.

- Shift to neutral body positions.
- Periodically relax your arms, letting them hang by your side.
- Keep your shoulders relaxed, your neck straight and your elbows by your side.
- Relax your back by aligning its three gentle curves:
  - In at the neck
    - Out in the chest
      - In again at your lower back.
- Avoid slumped sitting positions, rounded shoulders, sway back or an overly straight, stiff posture.
- Adjusting the height of your workstation or chair so that your hands are about two inches above or below your elbow.
- Keeping commonly used items located within arm's reach.

### **20.1.2. Reducing Back Strain**

- Select a chair with a firm, padded back that adjusts vertically and horizontally.
- Use a lumbar cushion or rolled towel against your lower back if your chair doesn't provide lower back support.
- Adjust the chair so that:
  - Your feet are flat on the floor;
  - Your knees are at the same height as your hips;
  - Your work surface is at your waist.
- Sit close to your work so that you don't bend over it.

### **20.1.3. Minimizing Stress and Strain**

Here are a few tips on how computer users can minimize daily stress and strain.

- Use a padded swivel chair.
- Position equipment carefully.
- Place the top of your video monitor at eye level.
- Keep wrists in a neutral position.
- Place the keyboard at elbow height and at a slight incline.
- Use wrist pads to support your wrists.
- Use a hard-copy holder.
- Reduce the glare on monitors.
- Use indirect lighting
- Install diffusers on lights and use shades or blinds on windows.
- Exercise your eyes by periodically looking away from your work and focusing on something else.

- Take regular mini-breaks to minimize strain all over the body.
- Circling, shrugging, stretching and arching help to increase your circulation and relieve tension. Varying your work routine also helps relieve tension.

## **20.2. FIRE SAFETY IN THE OFFICE**

The best way to fight fires is to prevent them. Good office housekeeping is the key. Trash should always be placed in appropriate containers and emptied daily.

Fires can result from:

- Overheated equipment
- Overloaded conductors
- Short circuits
- Damaged electrical cords

Fire is fast! A small flame can ignite a whole room within three minutes. Soaring temperatures can sear lungs and melt clothing. A relatively small fire can fill the work area with thick, black, blinding smoke full of toxic vapors. Of all fire-related deaths, carbon monoxide poisoning causes 75 percent.

Know where fire extinguishers are located and learn how to effectively use one before an emergency occurs. You may contact the Environmental Health and Safety Department to schedule training.

If a fire cannot be extinguished, go to the nearest exit, and evacuate. Don't forget the last person out of a room must close the door to prevent the fire from spreading. In a multiple story building the stairwell will be your primary escape route.

### **REMEMBER:**

- NEVER prop stairwell doors open.
- Work your way to lower levels.
- NEVER use the elevator.
- Go to your department's predetermined meeting place so that a head count can be taken.

### **IF YOU BECOME TRAPPED:**

- Don't Panic.
- Look for another exit.
- Feel doors for heat with the back of your hand. If it's hot don't open it.
- If you can't find an alternative way out, stay where you are.
- Use anything available to seal doors, windows and vents from smoke, heat and flames.
- If there is a phone, call the fire department and give your exact location.
- Stay low to avoid smoke and heat. Temperatures can be 90 degrees near the floor and 600 degrees at eye level.

### **20.2.1. Preventing Electrical Fires**

Electrical equipment requires special care. Frayed electrical cords, loose or broken electrical wires, broken outlet covers and receptacles and worn or broken electrical plugs are dangerous and should be repaired or replaced before being used.

Moisture and electricity do not mix. Placing liquids on or around electrical equipment (such as computers, radios, copiers, printers or microwaves) increases the risk of electrocution if the liquid spills and gets into the electrical equipment.

Do not block or store within 36 inches of electrical panel doors. If an electrical malfunction should occur, the panel door, and anything else in front of the door will become very hot.

To prevent electrical fires:

- Replace damaged cords or plugs.
- Keep cords away from heat and water.
- Never run cords under rugs.
- Never remove the third prong on a grounded plug.
- Avoid plugging too many cords into an electrical outlet.
- Use multi-outlet electrical strips with a built-in breaker.
- Only use an extension cord if absolutely necessary. Be sure it is grounded and can safely handle the current it will be conducting.
- Always pull an electrical cord from an outlet by the plug and never by the cord.

### **20.3. SLIPS, TRIPS AND FALLS**

Falls are the second most common type of job related accident. Half of all fall injuries are sustained by office workers. With a little awareness, you can avoid serious injuries caused by falls.

#### **20.3.1. SLIPS**

Whenever possible stay off wet floors. If you have to walk on a wet floor:

- Slow Down
- Shorten your stride
- Point your toes out slightly
- Make wide turns
- Watch out for spills, leaks or drips. Clean up or identify puddles with a chair or trashcan.



### **20.3.2. TRIPS**

Always keep the workplace clean and clutter free. A piece of paper or pencil stepped on just right can be very dangerous. Take extra care when walking from carpeted to smooth hard surfaces.

- Take your time and watch where you are going.
- Keep walkways clutter free
- Never leave file cabinet drawers open.
- Secure loose carpeting and cut loose threads.
- Never run loose power cables across a walkway.
- Never run power cords under carpet.

### **20.3.3. FALLS**

Falls can occur in a number of ways, remember the precautions below:

- Take it easy on stairways and use the handrail.
- Never leave objects on staircases.
- Always use a ladder or step stool to retrieve anything above shoulder level.
- Lock the ladder into position.
- Whenever you place a ladder in front of a door, secure the door so no one can open it.
- Ladders or step stools should be sturdy and not have any broken rungs or legs.
- Swivel chairs are not acceptable ladder substitutes.

## **20.4. *Filing Cabinets/Bookcases***

Filing cabinets and bookcases can be dangerous if used incorrectly.

1. Drawer and doors should be returned to the closed position when not in use so as to prevent bumping and tripping. Under no circumstance should more than one drawer or door be open at a time. This could cause the cabinet to overturn.
2. File cabinets and or bookcases should be placed where their use will not interfere with office traffic patterns.
3. File cabinets or bookcases taller than 64 inches should be secured or anchored to the wall to prevent toppling over.
4. Heavy items should be stored in the bottom of the File cabinet or bookcase. Never store boxes or large items overhead.

## **21. WORK RELATED INJURIES/ILLNESSES**

The University seeks to maintain a healthy and safe work environment for its employees while containing costs. Therefore, the University will promptly provide medical services for an injured employee in connection with the work-related injury or illness received.

All University employees are covered under the Arkansas Workers' Compensation Act, including full time faculty and staff, part-time employees, temporary employees and student employees. Any employee who suffers an on-the-job injury or an occupational illness within the meaning of the Workers' Compensation Act is entitled to file a claim for benefits provided by the Act.

### **21.1. Reporting on the Job Injuries**

1. Employees are required to notify their direct supervisor immediately following a legitimate injury or disease arising out of and in the course of their employment. All accidents or injuries must be reported to the Environmental Health and Safety Department by completing the Accident Report Form found in Appendix B of this manual.
2. The supervisor is required to complete a First Report of Injury or Illness and Employers Supplemental Report within Twenty-four (24) hours of initial injury or illness.
3. The injured employee is required to complete Employee's Report of Accident and Employee's Notice of Injury within (24) hours of initial injury or illness.

*Note: A copy of these forms may be obtained from the Environmental Health and Safety Department*

### **21.2. Medical Treatment for Work Related Injuries/Illnesses**

1. All minor work related injuries can be treated with First Aid Kits found in their respective departments. If an injured employee has a minor work related injury that cannot be cared for with the First Aid Kit, those employees need to seek treatment from the Student Health Center.
2. The Employer (Arkansas State University) will choose the initial treating Physician. All non-emergency/life threatening injuries should be treated at: First Care – Stadium Clinic, 333 Stadium Blvd., Jonesboro, Arkansas 72401, (870) 932-3339. All major medical emergencies should be treated at: St. Bernard's' Regional Medical Center, 224 East Matthews, Jonesboro, Arkansas 72401, (870) 972-4100.

3. The Employer (Arkansas State University) will establish a primary pharmacy for all Workers' Compensation injuries that require a disbursement of medications. Approval for all prescriptions will be phoned into the Environmental Health and Safety Department. All employees with work related injuries should take their prescriptions to: Soo's Health Mart Drugs, 2905 East Nettleton Avenue, Jonesboro, Arkansas 72401, (870) 932-6930. An employee has the right to select to use another pharmacy. Should the employee do so they would need to submit their pharmacy receipts to the Environmental Health and Safety Department for reimbursement.

### **21.3. *Required Documentation from Treating Physician***

All paperwork associated with the employees' claim for injury (doctor's reports, return to work slips, referrals to specialty physicians, etc) must be submitted to the Environmental Health and Safety Department.

### **21.4. *False Representation***

Employees making false claims, representations or statements for the purpose of obtaining Workers' Compensation coverage will be guilty of a Class D felony. Punishable with up to 6 years in prison and up to a \$10,000 fine.

### **21.5. *Accident/Incident Reports and Analysis***

The Safety Supervisor will maintain an accurate file for all work-related accidents and incidents. The Safety Supervisor will perform, or cause to be performed, an investigation and analysis of each serious accident involving bodily injury or property damage occurring at Arkansas State University and provide necessary information to the appropriate department for corrective action. A record of the Safety Supervisors' findings and recommendations will be maintained in the Environmental Health and Safety Department.

## **22. SAFETY AND HEALTH AUDITS**

The Safety Supervisor will conduct annual health and safety audits of all facilities on an annual basis with recommendations for corrective action to be provided to the appropriate department. This audit is an audit of campus compliance and is not to be construed as an evaluation of any individual's performance. Copies of the Safety Supervisors findings of these audits will be kept on file in the Environmental Health and Safety Department.

### **22.1. *REGULATORY AGENCY INSPECTIONS***

Safety and Health regulatory agencies may make unannounced inspections of Arkansas State University facilities from time to time. Regulatory agencies generally have authority to enter public or private property connected with an activity governed by a permit or regulation. These regulatory agencies include the Arkansas

Department of Labor, the Arkansas Department of Health, and the Jonesboro Fire Marshal. Inspections may be conducted for a variety of reasons, including: response to employee or community complaints, response to noncompliance activities, records review, errors or violations in compliance reports, fact-finding in support of a permit/license application files by a facility, periodic visits as mandated by Agency inspection procedures.

Inspections typically include a facility or work area walk-through focused upon the work area, record review, personnel interview, measurements, tests or sampling activities. If a regulatory agency visits a facility of Arkansas State University, the following procedures should be followed:

1. **Identify:** Verify the inspector's credentials upon arrival. Obtain, the name of the Agency, the name of the inspector(s), and telephone number of the inspector(s). Ask the inspector(s) to wait until a representative from the Environmental Health and Safety Department arrives. Call the Environmental Health and Safety Department immediately.
2. **Notify:** If the inspector(s) is not with an Environmental Health and Safety Department representative, immediately notify the Environmental Health and Safety Department that an inspection is about to begin or is already in progress.
3. **Pre-inspection Meeting:** Before an inspection begins, request a pre-inspection meeting if the inspector does not announce that a pre-inspection meeting is to be conducted, to determine the nature and extent of the inspection. The inspector(s) may wish to speak with a qualified person to clarify a technical issue, may wish to review records for a particular program, or may wish to visit operating areas of the facility to verify compliance with a regulatory requirement. Ask the inspector(s) to describe the purpose of the visit, the information that he/she must obtain, and the reason why the inspection is taking place. Depending on the area to be inspected, a representative from that area may be asked to attend the pre-inspection or opening conference.
4. **Health and Safety Procedures:** Ensure that the inspector follows the safety procedures established for your work area (e.g., safety glasses, hearing protection, etc.). Do not allow entry into manholes, confined spaces, or high hazard areas (e.g., high voltage, etc.) without contacting the Environmental Health and Safety Department.
5. **Closing Meeting:** A closing meeting will either be held at the conclusion of the inspector's visit or at a later date after the regulatory agency has reviewed their findings. The Agency's findings, follow-up actions and any other decisions will be presented at this time. A representative from the specific areas reviewed may be requested to attend the closing conference.
6. **Reporting:** An Environmental Health and Safety representative will serve as

the point of contact for any additional correspondence or further information requested by the inspector.

7. **Follow-up Report:** A report should be written by the Safety Supervisor or the supervisor of the area inspected to be maintained on file in the Environmental Health and Safety Department. The report should also detail the inspecting agency, the inspector name(s), nature and purpose of the visit, areas inspected, records that were reviewed or exchanged, sampling that was conducted and the results, personnel interviewed, any additional information provided by the inspector.
8. **Recordkeeping:** The Environmental Health and Safety Department will maintain all official University records (e.g., official related correspondence, results, analyses, photographs, follow-up reports, corrective actions, etc.) generated as a result of a visit to Arkansas State University by a safety and health regulatory agency.

## **23. UTILITY AND SLOW MOVING VEHICLE SAFETY & TRAINING PROGRAM**

This policy provides guidelines for the use of electric or gas-powered carts and/or similar slow moving vehicles (SMV) on the campus of Arkansas State University. The intent is to establish proper safety procedures and practices, as well as to promote and provide for a safer environment for students, faculty and staff.

### **23.1 STATEMENT OF POLICY**

All members of the University community are governed by this policy (students, staff, faculty and contractors/vendors). All operators of carts and/or SMV's must meet the following criteria before operating a cart on property under the jurisdiction of Arkansas State University:

- Possess a valid Arkansas driver's license.
  - Know and adhere to the State of Arkansas motor vehicle laws.
  - Successfully complete the Utility and SMV Safety Training Program offered and provided by the Environmental Health and Safety Department.
1. The safe operation of carts and/or SMV's is paramount. Failure to follow this policy, render common practices or courtesies, or follow rules of the road for the State of Arkansas, could result in citation, appropriate disciplinary action, and/or suspension of operator's cart/SMV driving privileges.
  2. All new cart/SMV acquisitions must meet the minimum safety features found in National Highway Safety and Traffic Administration (NHSTA),

Standard 500 (49CFR Part 571.500), hereafter “Standard 500”. As of the effective date of this policy, the purchase of used or remanufactured carts/SMV’s not meeting Standard 500 is prohibited. Contractors and other non-affiliated departments/companies, corporations, etc. carts/SMV’s must meet Standard 500.

3. Standard 500 carts/SMV’s must be maintained so that all original equipment safety features are kept in good working order.
4. Minimum safety features for carts/SMV’s not Standard 500 (acquired by Department prior to effective date of this policy) are to include:
  - Carts/SMV’s must be four-wheeled vehicles – **No three-wheeled vehicles.**
  - All original equipment safety features must be kept in good working order.
  - All carts/SMV’s and trailers (pulled by carts/SMV’s) must have clearly displayed on the exterior of the cart/SMV and trailer the slow moving vehicle reflective triangle.
5. The following outlines procedures for the safe operation of carts/SMV’s:
  - Supervisors must monitor and ensure that all persons operating carts/SMV’s have been instructed in the safe operation of carts/SMV’s and have attended the Cart/SMV Safety Training Program.
  - The speed limit for carts/SMV’s off standard roadways is **10 mph (5 mph when pedestrians are present).**
  - Carts/SMV’s may operate on University roadways, but must adhere to posted speed limits. Carts/SMV’s must operate only on University campus/property. All cart/SMV’s should travel in the right hand lane, unless turning left. The attached map will designate the outer boundaries, and the interior sidewalks/walkways which cart/SMV operation is allowed. All carts/SMV’s operated on the ASU Farm must operate on **Farm property and roadways only.**
  - Modification or tampering with a carts/SMV’s governor is prohibited and is a violation of Federal Law.
  - The operator must report any accidents to the University Police Department and to the operator’s supervisor.
  - Cart/SMV operators are to use extreme caution at all times.

- Operators may **not** wear headsets while operating cart/SMV's.
  - Pedestrians have the right-of-way on campus. Cart/SMV's must yield to pedestrians on sidewalks. **SPEED IS TO BE REDUCED TO A MINIMUM (5 mph max.) WHEN DRIVING ALONG OR CROSSING SIDEWALKS SO AS TO AVOID ACCIDENTS WITH PEDESTRIANS.**
  - Cart/SMV operators are to be diligent and pay particular attention to the needs of disabled persons, as limitations in vision, hearing or mobility may impair their ability to see, hear, or move out of the way of carts/SMV's.
  - Carts/SMV's are not to be overloaded, i.e. carrying more passengers than seating provided or overloading the cart/SMV's recommended carrying or load capacity.
  - The name of the University department, and University identification number (provided by the Facilities Management Department at the Department's expense) must be displayed prominently on University owned carts/SMV's. Contractors and other non-affiliated departments/companies, corporations, etc. must display company name and vehicle identification number on their cart/SMV at the owners expense.
  - Cart/SMV operators are responsible for ignition keys for the period of time in which they are using the vehicle. Keys shall not be left in cart/SMV's.
  - Operators must park cart/SMV's away from heavily traveled pedestrian areas in the designated **service and maintenance** parking areas.
  - Operators are not to block the path, limit pedestrian access on walkways, nor park at entrances to buildings.
  - University owned cart/SMV's are to be used for University business only.
6. All cart/SMV operators must attend the Utility and SMV Safety Training Program prior to operating a cart/SMV. This provision will go into effect Fall 2005. The Environmental Health and Safety Department will commence training immediately to properly train all existing personnel currently operating cart/SMV's the campus of Arkansas State University.
  7. University owned cart/SMV's are to be maintained in accordance with manufacturer and Facilities Management recommended service schedule.

- Repairs and regular maintenance are the responsibility of the Department owning the cart/SMV. The Departments are financially responsible for all repair and maintenance costs (labor, parts, and supplies). The Department is required to keep all preventative maintenance and repair records related to the cart/SMV; however, for those services provided by Facilities Management – Motor Pool, Motor Pool will keep those records.
  - Departments are responsible for keeping all original equipment and safety features in good working order.
8. Personally owned cart/SMV's are prohibited from operating on University property. However, special consideration will be given to ADA accommodations.



## **APPENDIX – A**

### **TRAINING PROGRAMS PROVIDED BY ENVIRONMENTAL HEALTH AND SAFETY**

**Blood Borne Pathogen Training:** Is provided to employees whose normal job duties will require them to come in contact with blood and body fluids. This will include Nursing and Health Professionals, Custodial Staff, University Police Officers, Athletic Trainers, Health Physical Education Center Employees and First Responders. This training includes:

- 1) Risk of working with blood and body fluids,
- 2) the University Exposure Control Plan,
- 3) Personal Protective Equipment,
- 4) Work Practice Controls,
- 5) Engineering Controls,
- 6) Incident Reporting and treatment plan.

**Chemical Right-To-Know Training:** Is required to be completed by ALL new employees and annually by All employees whose normal job duties require them to work with chemicals or hazardous products.

**Confined Space Training:** Is required to be completed by any employee serving as authorized entrant, attendant, or entry supervisor during any type of confined space operation (i.e. sewer manholes, underground tunnels, farm silos, pits, electrical vaults, etc.). Training will include:

- 1) Confined Space Permit System.
- 2) Specific Duties of each person involved in confined space operations.
- 3) The hazards of confined spaces including signs/symptoms and consequences of exposure.
- 4) Proper use of equipment required during confined space operations.
- 5) Communication procedures.
- 6) Rescue and evacuation processes.

**CPR (Cardiopulmonary Resuscitation):** Is available to ALL employees. Instruction in basic life support for an adult, small child and infant based on the American Heart Association Guidelines. Training will include:

- 1) Recognition of signs of heart attack and stroke
- 2) Activation of the EMS system
- 3) Use of the recovery position
- 4) Rescue breathing
- 5) One rescuer CPR
- 6) Relief of foreign-body airway obstruction

**Ergonomics:** Ergonomics is available to all employees upon request. Ergonomics involves arranging the environment to fit the person. In the workplace, ergonomics helps to adapt the job to fit the person, rather than force the person to fit the job. Adapting the job to fit the worker can help reduce stress and eliminate many potential injuries and disorders associated with the overuse of muscles, bad posture, and repetitive motion.

**First Aid - Basic:** Is available to all employees upon request, a minimum class size of six is required. Class content will include:

- 1) Breathing emergencies
- 2) Identifying and caring for bleeding
- 3) Sudden illness, injuries and preventing disease transmission

**Fire Extinguisher Operation/Fire Safety:** Is available to all employees upon request. The training will include:

- 1) Causes of fires
- 2) Classes of fires
- 3) Types of fire extinguishers
- 4) Using a portable fire extinguisher (PASS)
- 5) Evacuation procedures

**Forklift/Powered Industrial Truck:** Is required for all employees who operate Forklifts or Powered Industrial Trucks during the course of their employment. This training is divided into two sections, classroom training and hands on operation. This training is required to be completed *prior to* operating these vehicles and thereafter as required by law. The training will include:

- 1) Pre-start safety checks
- 2) Battery safety
- 3) Fire prevention
- 4) Accident causes and effects
- 5) Components of Powered Industrial Vehicles
- 6) Tires
- 7) Forks
- 8) Operating Principles
- 9) Do's and Don'ts

**Proper Lifting Techniques:** Each department that has employees who will perform manual material handling operations must contact the Environmental Health and Safety Department to schedule specialized training for proper lifting techniques. This training will include:

- 1) Training employees to utilize techniques that place minimum stress on the lower back.
- 2) Physical conditioning or stretching programs to reduce the risk of muscle strain.
- 3) Adjusting the height of a pallet or shelf. Lifting which occurs below knee height or above shoulder height is more strenuous than lifting between these lines.

**Lockout/Tagout:** The training requirements for Lockout/Tagout apply to employees who face a risk of electrical shock that is not reduced to a safe level by the electrical installation requirements. Employees in occupations facing a higher than normal risk of electrical accident are required to be trained (i.e. electricians and maintenance staff). Additionally, other employees who may reasonably be expected to face comparable risk of injury due to electric shock or other electrical hazards must also be trained. Employees shall be trained in, and become familiar with, the safety related work practices as outlined in the University's Control of Hazardous Energy (Lockout/Tagout) Program.

**Personal Protective Equipment:** The supervisor shall ensure that each employee who is required to use PPE is properly trained by the Environmental Health and Safety Department or by another compatible source. Each employee shall be trained to know at least the following:

- 1) when PPE is necessary;
- 2) what PPE is necessary;
- 3) how to properly put on, take off, adjust, and wear PPE;
- 4) the limitations of the PPE; and
- 5) the proper care, maintenance, useful life and disposal of PPE.

**Radiation Safety for Ancillary Employees:** Is required to be completed by all employees and students whose assignments involve working around radiation sources in order to provide special services needed to continue operations and who may routinely enter radiologically controlled areas and encounter radiological barriers, postings, radiation sources, or radioactive materials. This would include administrative support staff, Facilities Management maintenance and custodial staff, faculty and students.

**Respiratory Protection:** Employees, whose positions require the use of a respirator must contact the Environmental Health and Safety Department to schedule a medical evaluation, respirator fit test and training. Training will be provided to all users of respiratory protective equipment and will include:

- 1) Selection of respirators;
- 2) Inspection, maintenance, storage and cleaning of respirators;
- 3) Respirator limitations and emergency procedures;
- 4) Methods of donning, adjusting and fit-checking (hands-on);
- 5) Respiratory hazards

# ARKANSAS STATE UNIVERSITY



Downloaded on October 14, 2014  
from <http://ehc.astate.edu/Biological%20Safety%20Manual.htm>

**A PUBLICATION PROVIDED BY:  
OCCUPATIONAL SAFETY**

[www.astate.edu](http://www.astate.edu)

**ASU**  
ARKANSAS STATE  
UNIVERSITY

**Arkansas State University  
Arkansas Biosciences Institute**

**NOTES**

**(October 14<sup>th</sup>, 2014)**

---

**Biological Safety Manual**

---

1. Date this manual was officially last updated: May 15<sup>th</sup>, 2007.
  2. Original text is in **black** characters. No original text has been deleted.
  3. Updates are in **red** colored characters, and should be considered as suggestions only.
  4. Updates to hyperlinks are indicated in **red** characters on **yellow** background. Inactive hyperlinks in the original text have NOT been deleted; they have been just turned to **black** color from the original **blue** color.
  5. Hyperlink updates have been identified in pages: 4, 9, 10, 11, 18, and 64.
-

## TABLE OF CONTENTS

Chapter 1 Biological Safety Manual Overview .....	3
1.1 Introduction .....	3
1.2 Manual Purpose .....	3
1.3 Biohazardous Material Definition .....	3
1.4 ASU-Jonesboro Biological Safety Program .....	3
1.5 Role and Responsibilities.....	4
1.5.1 Principal Investigators and Supervisors (Registered Users).....	4
1.5.2 Biohazard Workers .....	5
1.5.3 Ancillary workers (non-biohazard qualified personnel).....	5
1.5.4 Deans, Directors, Administrators, and Department Heads .....	6
1.5.5 Environmental Health and Safety Department .....	6
1.5.6 Institutional Biological Safety Committee (IBSC).....	7
Chapter 2 Training and Information Resources.....	8
2.1 Training Policies.....	8
2.2 Training Courses Provided .....	8
2.3 Classifications of Biohazardous Materials .....	9
2.3.1 Infectious Agents and Biological Toxins.....	9
2.3.2 Recombinant DNA .....	9
2.3.3 Animal or Animal Products .....	10
2.3.4 Plants or Plant Pests.....	10
2.4 Other Biological Safety Information Resources.....	10
Chapter 3 Acquisition of Biohazardous Materials.....	12
3.1 Acquisition Policy.....	12
3.2 Becoming a Registered User.....	12
3.3 Acquisition of Biohazardous Materials .....	12
3.3.1 Purchases .....	12
3.3.2 Biohazardous Material Exemptions.....	13
Chapter 4 Working Safely with Biohazardous Materials .....	14
4.1 Basic Biological Safety Practices .....	14
4.2 Biological Safety Principles and Concepts.....	15
4.2.1 Laboratory Biological Safety Level Criteria .....	16
4.2.2 Vertebrate Animal Biological Safety Level Criteria .....	17
4.2.3 Recombinant DNA Biological Safety Level Criteria .....	18
4.3 Standard Operating Procedures .....	19
4.3.1 General Procedures.....	19
4.3.2 Personal Protective Equipment.....	23
4.3.3 Risk Assessments.....	24
4.3.4 Blood Borne Pathogens and Universal Precautions .....	25
4.3.5 Laboratory Specific Exposure Control Plan .....	25
4.3.6 Handling and Storage of Biohazardous Materials .....	26
4.3.7 Biological Safety Cabinets and Other Engineering Controls .....	27
4.3.8 Biohazard Warning Signs and Labels.....	28
4.3.9 Special Provisions for Select Agents and Biological Toxins .....	31
Chapter 5 Biohazardous Unwanted Materials Management .....	32
5.1 Biohazardous Unwanted Materials Description .....	32
5.2 Biohazardous Unwanted Materials Disposal Policies .....	32
5.3 Biohazardous Material Laboratory Closure.....	33
Chapter 6 Biohazard Emergency Response Procedures.....	34
6.1 Introduction .....	34

6.2	Immediate Biohazard Emergency Response .....	34
6.2.1	Immediate Emergency Response Actions .....	34
6.2.2	Follow-up Response and Disinfection Actions .....	34
6.2.3	Airflow and Power Failures of Biological Safety Cabinets.....	35
6.3	Detailed Biohazard Emergency Response.....	35
6.3.1	General Comments on Emergencies.....	35
6.3.2	Reporting of Biohazard Emergency Incidents.....	36
6.3.3	Biohazard Emergency Response Procedure .....	37
6.3.4	Re-entry after Biohazard Incidents.....	41
6.3.5	Accident Investigation .....	42
6.3.6	Risk Assessment Resources/Information.....	43
6.3.7	Laboratory Biological Safety Spill Kits.....	43
Chapter 7	Biohazardous Material Transportation.....	44
7.1	General ASU-Jonesboro Biohazardous Shipping Policies .....	44
7.2	Biohazardous Material Transportation and Transfer Resources.....	44
7.2.1	Biohazardous Material Transportation .....	44
7.2.2	Transportation of Materials within Laboratory - High Risk.....	44
7.2.3	Biohazardous Material Transfer .....	45
Appendix A	Biohazardous Material Application.....	46
Appendix A-1	Recombinant DNA Registration Document .....	47
Appendix A-2	Biohazardous Materials and Select Agent Registration Document.....	48
Appendix A-3	Blood born Pathogens and OPIM Registration Document.....	49
Appendix A-4	Select Agent and Radioactive Material Application.....	50
	HHS Select Agents .....	51
	USDA List Of Livestock Pathogens And Toxins.....	52
Appendix B	Biohazard Laboratory Self-Inspection Checklist.....	53
Appendix C	Practical Biosafety Guidelines.....	55
Appendix D	Biosafety Laboratory Self-Inspection Checklist.....	58
Appendix E	Laboratory Specific Exposure Control Plan .....	60
Appendix F	Sterilization and Disinfection .....	65
Appendix G	Autoclave Program .....	71
Appendix H	Sharps and Laboratory Glass .....	74
Appendix I	Laboratory Biosafety Spill Kit Checklist.....	77
Appendix J	Biosafety Cabinet Summary Chart .....	78
Appendix K	Laboratory Security Issues.....	79
Appendix L	Biohazard Warning Signs .....	80



# Chapter 1

## Biological Safety Manual Overview

### 1.1 Introduction

This chapter contains general information about the Arkansas State University - Jonesboro (ASU) Biological Safety Program. Of particular interest in this chapter are the Biological Safety program purpose, biohazardous material definition, Biological Safety program goals, campus policies, and roles and responsibilities.

### 1.2 Manual Purpose

The Biological Safety Manual presents the ASU – Jonesboro Biological Safety Program, which is designed to protect students, faculty, staff, and the public from potential adverse exposure to biological material used in research and teaching activities at Arkansas State University.

### 1.3 Biohazardous Material Definition

The ASU – Jonesboro Biological Safety Program applies to all materials containing recombinant DNA (rDNA) and Biological Safety Level 2 (BSL-2) research activities (see Section 2.3). Currently, BSL-3 and 4 research activities are not allowed at the ASU-Jonesboro campus.

Biohazardous materials are any microorganism, or infectious substance, or any naturally occurring, bio-engineered, or synthesized component of any such microorganism or infectious substance, capable of causing: 1) death, disease, or other biological malfunction in a human, an animal, a plant, or another living organism; 2) deterioration of food, water, equipment, supplies, or material of any kind; or 3) harmful alteration of the environment. These include, but are not limited to:

- Certain bacteria, fungi, viruses, rickettsiae, protozoa, parasites
- Recombinant products
- Toxins of biological origin
- Allergens
- Cultured human or animal cells and the potentially infectious agents these cells may contain
- Viroids and prions
- Other infectious agents as outlined in laws, regulations, or guidelines.

Examples include all materials containing rDNA; transgenic animals or plants; human, animal or plant pathogens; biological toxins (such as tetanus toxin); human blood and certain human body fluids; select agents; high consequence livestock pathogens and toxins; and human or monkey cell cultures.

### 1.4 ASU-Jonesboro Biological Safety Program

Biological Safety is a complete program of recognition, evaluation, and control to minimize the health risk to students, faculty, staff, and the public from potential exposure to biohazardous materials that are used in the research and teaching activities at the ASU – Jonesboro campus. To be effective this program needs the active participation of faculty, staff and students. The Biological Safety Program is designed to:



- Enhance Biological Safety knowledge for University Faculty, Staff, and Students.
- Assist researchers in protecting personnel, the environment and property from exposure.
- Provide the process and tools to assess safety needs and precautions for emergency response, planning, initiation, and termination of activity involving biohazardous materials.
- Provide an environment for high quality research while maintaining a safe work place.
- Comply with applicable federal, state, and local requirements.

The Environmental Health and Safety Department in conjunction with the Institutional Biological Safety Committee administers the ASU-Jonesboro Biological Safety Program. Our mission is to work with the campus community to develop and implement an efficient, convenient, comprehensive, and forward-looking Biological Safety program. The campus has an Institutional Biological Safety Committee (IBSC) to provide oversight of the program. Additional Biological Safety Program information is available on the Environmental Health and Safety Department Website. <http://ehc.astate.edu/> (update: <http://www.astate.edu/a/ehs/>)

## 1.5 Role and Responsibilities

For the purposes of the ASU-Jonesboro Safety Program, the campus community is divided into six categories for roles and responsibilities. Individuals may fall into more than one of these categories:

- Principal Investigators and Supervisors (Registered Users)
- Biohazard Workers
- Ancillary Workers (Non-Biohazard Qualified Personnel)
- Deans, Directors, Administrators, and Department Heads
- Environmental Health and Safety
- ASU-Jonesboro Institutional Biological Safety Committee (IBSC)

### 1.5.1 Principal Investigators and Supervisors (Registered Users)

Principal investigators and supervisors (Registered Users) have primary responsibility for safety when work is conducted with biohazardous materials. Their responsibilities include:

- Submit registration forms to the Environmental Health and Safety Department of locations where rDNA or Biological Safety Level 2 research activities are conducted (Section 3.2).
- Submit the initial research protocol and any subsequent changes to the IBSC for review and approval prior to initiating rDNA or Biological Safety Level 2 research activities.
- Submit annual renewal form to IBSC for all rDNA and Biological Safety Level 2 research activities (Section 3.2).
- Report any newly identified select agents, high consequence livestock pathogen or toxins and plant pathogens immediately to the Environmental Health and Safety Department.
- Notify the Environmental Health and Safety Department of all persons who use biohazardous material in their work location and ensure these persons receive appropriate training.
- Maintain a current and up-to-date inventory of biohazardous material
- Complete and post appropriate biohazard signs, labels and Emergency Notification Signage.

- Request collection of Biohazardous by Environmental Health and Safety of unwanted Materials in a timely manner.
- Ensure availability of reference information on biological hazards, and ensure that all staff understand how to use these references.
- Conduct risk assessments of each task involving biohazardous material. Assess risks in order to set the Biological Safety Level for the proposed work. Make an initial determination of the required levels of physical and biological containment in accordance with the ASU-Jonesboro Biological Safety Manual; select appropriate microbiological practices and laboratory techniques to be used for the research.
- Ensure that all workers under their supervision use proper Personal Protective Equipment.
- Understand the proper procedures to use in the event of a release or other emergency.
- Work with the Environmental Health and Safety Department to maintain safe work areas that comply with university policies and Federal, State & Local regulations.
- Comply with shipping requirements for recombinant DNA and biohazardous materials.
- Control Ancillary Worker access to areas where biological hazards may be present.
- Complete proper Biohazardous Materials Laboratory Closure prior to termination of work with biohazardous materials.

### **1.5.2 Biohazard Workers**

Biohazard Workers are persons who work under the supervision of a Principal Investigator or Supervisor (Registered User). Most of these employees work with biohazardous materials on a daily basis. Their responsibilities include:

- Complete the Introduction to Biological Safety training course and then the Biological Safety refresher course a minimum of every two years thereafter.
- Report promptly all accidents, biohazardous exposures, work (or possibly work) related illnesses, hazardous circumstances and incidents to their supervisor.
- Know and follow all proper protocols and procedures for acquisition, use, storage, and disposal of biohazardous materials.
- Know where to find and how to properly use reference information and resources on biohazardous materials.
- Know how to respond to releases and other emergencies involving biohazardous materials.
- Be familiar with and use personal protective equipment needed for safety.
- Work with the Environmental Health and Safety Department to maintain safe work areas that comply with University policies and Federal, State and Local regulations.

### **1.5.3 Ancillary workers (non-biohazard qualified personnel)**

Ancillary Workers are persons who work in areas containing biohazardous materials, but who do not normally work directly with these biohazardous materials. Examples of ancillary workers are custodial staff, maintenance staff, delivery and University Police Officers and visiting personnel. Their responsibilities are as follows:

- Attend the ancillary worker biological safety training course and subsequent refresher training every year thereafter.
- Take precautions to avoid disturbing biohazardous materials.

- Report releases and other unsafe conditions involving biohazardous materials to the Environmental Health and Safety Department.
- Be familiar with and use proper personal protective equipment needed for safety.
- Request assistance from your Supervisor and the Environmental Health and Safety Department when uncertain about risks related to biohazardous materials.

#### **1.5.4 Deans, Directors, Administrators, and Department Heads**

Deans, Directors, Administrators, and Department heads have the following responsibilities:

- Be familiar with the ASU-Jonesboro Biological Safety program guidelines and provide safety leadership.
- Assist the Environmental Health and Safety Department in communicating major announcements and identifying appropriate personnel for Registered User status.
- Review biological safety inspections, provided by Environmental Health and Safety, to assist in resolving problem situations.
- Identify funding sources when needed to correct safety hazards and ensure that appropriate facilities are available to control biohazards.
- Assure that the Principal Investigator and all personnel have necessary training.
- Assure proper laboratory closure is completed prior to termination of biohazardous material use or storage.

#### **1.5.5 Environmental Health and Safety Department**

The Environmental Health and Safety Department is the campus administrative unit that oversees the Biological Safety Program.

Specific responsibilities of the Environmental Health and Safety Department include:

- Develop guidelines for the campus community so that biohazardous materials are used safely and in compliance with Federal, State and Local government regulations.
- Maintain databases of information related to the ASU-Jonesboro Biological Safety program.
- Provide or arrange appropriate training programs to meet the campus community needs.
- Provide periodic monitoring of areas where biohazardous materials are used or stored to assure that program guidelines are met.
- Advise the campus community on biological safety matters.
- Collect and dispose of unwanted biohazardous materials in an environmentally sound manner.
- Assist in arrangement for the proper shipping and transportation of biohazardous materials.
- Serve as the liaison with regulatory agencies such as Center of Disease Control and Prevention, National Institutes of Health, Department of Transportation, Department of Agriculture, Arkansas Department of Health, and Arkansas Department of Labor.

### **1.5.6 Institutional Biological Safety Committee (IBSC)**

The Institutional Biological Safety Committee is appointed by the Associate Vice Chancellor for Research and Technology Transfer to oversee the campus Biological Safety Program. Specific responsibilities of the committee include:

- Review and recommend policies and guidelines that ensure biological safety procedures, equipment, facilities, and training are appropriate for the biohazard risk.
- Perform an annual audit of the Biological Safety program on the Jonesboro campus.
- Review and approve all use of rDNA or Biological Safety Level 2 materials prior to work being conducted.
- Review assessments of Registered Users, and assist in resolving problems.
- Provide a campus forum for addressing issues involving biohazardous materials.

## **Chapter 2**

### **TRAINING AND INFORMATION RESOURCES**

This chapter describes training and information resources to assist the ASU-Jonesboro community in working safely with biohazardous materials. Classification of biohazardous materials is included in this chapter.

#### **2.1 Training Policies**

All persons working with biohazardous materials must have appropriate training with a refresher course every two years. New employees are required to take an introductory course. A separate training course is available for Ancillary Workers. Once initial training is received, a refresher is required every year. Where applicable, Blood Borne Pathogens training - Universal Precautions must be taken initially followed by annual refreshers. All persons who work with animals need to be evaluated under the Institutional Animal Care and Use Committee. The Principal investigator is responsible for determining the type of training for individuals, based on their contact with the project.

All persons working with or around biohazardous material(s) must:

- Be instructed in the laboratory specific exposure control plan, including: entry control procedures; the meanings of the various signs, signals or other controls used; applicable emergency procedures; recognition and prevention of dangerous situations and/or exposures; and the symptoms (acute and chronic) of possible exposures.
- Receive documented training in basic Biological Safety controls; applicable directives (including use of this manual); and specific preventative control methods and requirements of their work and work area.

#### **2.2 Training Courses provided by the Environmental Health and Safety Department**

Environmental Health and Safety provides the following training courses for those involved with biohazardous materials.

- Introduction to Biological Safety- Basic Microbiological Safety Practices and Techniques and material acquisition
- Biohazardous Materials Management Refresher (every 2 years)
- Biohazardous Materials Handling and Safety for Ancillary Workers
- Biohazardous Materials Ancillary Refresher (every year)
- Blood Borne Pathogen Training - Universal Precautions
- Blood Borne Pathogen Training - Universal Precautions Annual Refresher
- Biological Safety Cabinet Training

These courses are provided to general audiences, or can be customized to the specific needs of individual departments or work groups. The Environmental Health and Safety Department also provides training to meet related departmental needs or interests upon request.

## 2.3 Classifications of Biohazardous Materials

Proper classification of biohazardous material is the first step of the risk assessment process. These resources assist users in identifying and understanding risk factors associated with the specific biohazardous material used. Risk Assessments for the "Biohazardous Materials Risk Assessment Checklist" can be found in section 4.3.3. This checklist provides a practical guide to risk assessment.

### 2.3.1 Infectious Agents and Biological Toxins

Biological Safety in Microbiological and Biomedical Laboratories - 4th Edition (BMBL)

- Prudent Biological Safety Level 1-4 practices, procedures, and facilities described for manipulations of infectious agents in laboratory settings and animal facilities.

American Biological Safety Association Risk Group Classification for Infectious Agents

- Risk group classifications that are primarily used in the research environment as part of a comprehensive Biological Safety risk assessment.

<http://www.absa.org/>

U.S. Public Health Service (USPHS) Foreign Quarantine (42 CFR 71)

- CDC Importation Permits for Etiologic Agents

<http://www.cdc.gov/od/eaipp/>

CDC Additional Requirements for Facilities Transferring or Receiving Select Agents Regulation (42 CFR 72.6)

- Registration program for shipping infectious agents and biological toxins designated as "Select Agents".

<http://www.cdc.gov/od/sap> (update: <http://www.selectagents.gov>)

U.S. Occupational Safety Department and Health Administration (OSHA) Blood-borne Pathogens Standard (29 CFR 1910.1030)

- Covers human blood, other potentially infectious human body fluids or tissues and human cell lines.

<http://www.osha.gov/SLTC/bloodbornepathogens/index.html>

### 2.3.2 Recombinant DNA

NIH Guidelines for Research involving Recombinant DNA Molecules (NIH Guidelines)

- NIH requirements for Campus Research with Recombinant DNA in humans, animals, and plants.

<http://www4.od.nih.gov/oba/rac/guidelines/guidelines.html>

(update: [http://oba.od.nih.gov/oba/rac/Guidelines/NIH\\_Guidelines.htm](http://oba.od.nih.gov/oba/rac/Guidelines/NIH_Guidelines.htm) and

<http://osp.od.nih.gov/office-biotechnology-activities/biosafety/nih-guidelines>

USDA Introduction of Genetically Engineered Organisms Regulations (7 CFR 340)

- Biotechnology transport/introduction permits issued by the APHIS Biotechnology and Scientific Services branch

<http://www.aphis.usda.gov/biotechnology/index.shtml>

(update: <http://www.aphis.usda.gov/brs/pdf/7cfr340.pdf> and

<http://www.gpo.gov/fdsys/pkg/CFR-2008-title7-vol5/xml/CFR-2008-title7-vol5-sec340-4.xml>)

### 2.3.3 Animal or Animal Products

#### Institutional Animal Care and Use Committee (IACUC)

- The main purpose of the Committee is to assist University researchers and teachers who use animals in experiments. The committee guides and monitors research activities that involve animals by reviewing ASU animal care and use protocols and conducting routine inspections of facilities.

#### Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC)

- Promotes the humane treatment of animals in science through a voluntary accreditation program  
<http://www.aaalac.org>
- Presents an overview of governmental regulations regarding use of animals  
<http://www.aaalac.org/resources/usregs.cfm>

#### U.S. Department of Agriculture (USDA) Import-Export Regulations (7 CFR)

- Animal and animal products import/transport information  
<http://www.aphis.usda.gov/NCIE/>  
(update: [http://www.aphis.usda.gov/import\\_export/](http://www.aphis.usda.gov/import_export/))

#### Occupational Health and Safety in Care and Use of Research Animals (National Research Council)

- To promote occupational health and safety by recognizing and considering hazards and health risks associated with the care and use of research animals.  
<http://www.nap.edu/catalog/4988.html>

#### Guide for the Care and Use of Laboratory Animals (National Research Council)

- Provide information that will enhance animal well-being, the quality of biomedical research, and the advancement of biologic knowledge that is relevant to humans or animals.  
<http://www.nap.edu/catalog/1592.html>

### 2.3.4 Plants or Plant Pests

#### USDA Import-Export Regulations (7 CFR)

- Plant and plant pest import/export permits issued by the APHIS Plant Protection and Quarantine branch  
[http://www.aphis.usda.gov/plant\\_health/](http://www.aphis.usda.gov/plant_health/)  
(update: <http://www.aphis.usda.gov/wps/portal/footer/topicsofinterest/applyingforpermit>)

## 2.4 Other Biological Safety Information Resources

### American Biological Safety Association Resources

- <http://www.absa.org/index.shtml>  
(update: <http://www.absa.org/resmenu.html>)

### American Industrial Hygiene Association (AIHA) Resources

- <http://www2.umdnj.edu/eohssweb/aiha/>  
(update: <http://www.aiha.org>)

### Biological Safety Reference Manual - Second Edition (AIHA Publications)

- Information to address questions about laboratory, health care, and biotechnology biohazards in the workplace.
- Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets
  - <http://www.cdc.gov/od/ohs/biosfty/bsc/bsc.htm>  
(update: <http://www.cdc.gov/biosafety/publications/>)
- Anti-microbial Pesticides, EPA Office of Pesticide Programs
  - <http://www.epa.gov/oppad001/>

### Guidelines for the Safe Transport of Infectious Substances and Diagnostic Specimens, WHO (1997)

- <http://www.cdc.gov/od/ohs/biosfty/biosfty.htm>  
(update: [http://www.who.int/csr/emc97\\_3.pdf](http://www.who.int/csr/emc97_3.pdf))

### References to Inactivation of HIV and Herpes B

- <http://www.cdc.gov/od/ohs/biosfty/inactiv.htm>  
(update: [http://www.cdc.gov/hicpac/disinfection\\_sterilization/3\\_2contaminateddevices.html](http://www.cdc.gov/hicpac/disinfection_sterilization/3_2contaminateddevices.html))
- <http://www.cdc.gov/od/ohs/biosfty/herpesBinfo.htm>  
(update: <http://www.cdc.gov/herpesvirus/index.html>)



## **Chapter 3**

### **ACQUISITION OF BIOHAZARDOUS MATERIALS**

This chapter contains general information about ASU – Jonesboro policies and procedures to acquire biohazardous materials for rDNA or Biological Safety Level 2 research activities.

#### **3.1 Acquisition Policy**

The ASU Institutional Biological Safety Committee (IBSC) must review and approve research protocols or subsequent changes prior to initiating work with rDNA or Biological Safety Level 2 research activities. At this time, Biological Safety Level 3 and 4 (BSL - 3 & 4) work is not permitted within the Arkansas State University - Jonesboro campus. Principal Investigators and supervisors must submit an annual renewal to the IBSC for all rDNA and Biological Safety Level 2 research activities.

Biohazardous materials for rDNA or Biological Safety Level 2 research activities may only be obtained under the authority of the IBSC. There are similar requirements for the acquisition of radioactive materials (see the ASU Radiation Safety Manual).

Note: Select agents require special registration and tracking under the DHHS - Center for Disease Control and Prevention (CDC). High consequence livestock pathogen or toxins and plant pathogens require special registration and tracking under the USDA - Animal and Plant Health Inspection Service (APHIS). The USA PATRIOT Act restricts possession and access of personnel to Select Agents, High Consequence Livestock Pathogens and Toxins and Plant Pathogens. A list of these agents is presented in Appendix A-4.

#### **3.2 Becoming a Registered User**

Principal Investigators and supervisors, who are responsible for laboratories, and other locations where biohazardous materials for rDNA or Biological Safety Level 2 research activities are used, must submit to the Environmental Health and Safety Department a User Registration for Biohazardous Material Application Form, which can be found in Appendix A of this document. Approval by the Environmental Health and Safety Department is needed prior to purchasing, using, or storing those biohazardous materials. Proper completion of these forms provides the Environmental Health and Safety Department with information about the Registered User's name, location of work areas, and types of biohazardous materials used or stored at each location.

#### **3.3 Acquisition of Biohazardous Materials**

This section describes the various methods by which biohazardous materials for rDNA or Biological Safety Level 2 research activities may be acquired at ASU.

##### **3.3.1 Purchases**

When ordering bio-hazardous materials for use in research or instruction, a copy of the requisition must be sent to the Environmental Health and Safety Department. Information must include the principal users name, department and location where material will be used and stored.

Any supplier that requires campus safety authorization prior to initiating the purchase should be referred to the Environmental Health and Safety Department.

### 3.3.2 Biohazardous Material Exemptions

Biological materials that do not need to be procured under the authority of a Registered User are Biological Safety Level 1 research activities that do not involve rDNA.

Examples of such materials are:

- Biological Safety Level 1 research activities (except rDNA work) as defined in the "Biological Safety in Microbiological and Biomedical Laboratories" (BMBL) (4th Edition)
- Diagnostic and reference samples (Review for select agents and BSL-2 + activities).
- Student in vitro training that involve only BSL-1 classified agents, handling, and containment.

Although these biohazardous (biological) materials are exempted from the ASU-Jonesboro biohazardous materials purchasing policy, they must be properly stored, handled, and disposed. When exempt biohazardous (biological) materials become unwanted, the material must be properly decontaminated, inactivated or disposed of as unwanted biohazardous materials through Environmental Health and Safety.

Environmental Health and Safety discourages unnecessary stockpiling of biohazardous materials procured under the exemption.

## Chapter 4 WORKING SAFELY WITH BIOHAZARDOUS MATERIALS

This chapter contains guidance on working safely with biohazardous materials. Emphasis is placed on integrating Biological Safety practices and procedures with standard laboratory operations. Classification of Biological Safety Levels is included in this chapter.

### 4.1 Basic Biological Safety Practices

Persons working with biohazardous materials must be aware of potential hazards and must be trained and proficient in specific safety practices and techniques. The following Biological Safety practices are fundamental in using biohazardous materials safely:

- Identify and evaluate risks to develop a laboratory specific exposure control plan. Follow the Exposure Control Plan Template found in Appendix E to develop procedures for the specific biohazards present. Microbiological procedures or techniques to handle unknown biohazardous material, such as diagnostic use, should be designed to assume the worst-case risk scenario. Knowing how infectious organisms are transmitted and their infectious dose can help in evaluating the risk and avoiding infection. Information about the organism(s) should be gathered prior to commencing work with them. Refer to Sections 4.3.3 and 4.3.5 of this manual.
- Know where information resources for biohazardous materials can be found. Collect and communicate all the facts and information resources for biohazardous materials to appropriate personnel to minimize exposure risk. Refer to Chapter 2 and the Appendices of this manual.
- Make sure all biohazard signs and labels are present. Post appropriate biohazard signs and labels to assure only authorized personnel, informed of potential risks, enter areas where biohazardous material are used, see Appendix L. Access to all labs will be controlled. Protocols will be developed by the P.I. in accordance with Appendix K of this manual. Refer to Section 4.3.8 of this manual.
- Utilize appropriate safety equipment and facility design for the Biological Safety Level. Primary containment safety equipment, such as biological safety cabinets, is designed to reduce or eliminate exposure to biohazardous materials. Secondary containment facility design is intended to contain biohazardous materials in the laboratory so that they cannot cause harm to the public or the environment. Refer to Sections 4.2. and 4.3.7 of this manual.
- Maintain good housekeeping and personal hygiene. Good housekeeping is the most important step to improve safety. Good housekeeping also leaves a good impression upon visitors. Floors, laboratory benches, equipment, and other surfaces should be disinfected routinely. All biohazardous material waste should be autoclaved, sterilized, or placed in a biohazard Unwanted Materials container for disposal. Personal hygiene, such as frequent hand and laboratory clothes washing, should be observed at all times. Refer to Section 4.3.1 and Appendices E, F & G of this manual.

## 4.2 Biological Safety Principles and Concepts

The purpose of this section is to provide definitions of Biological Safety concepts.

**Pathogenicity or Virulence :** Pathogenicity or virulence is the ability of a biohazardous material to produce or develop a rapid, severe, or deadly disease. Some materials are highly pathogenic, even in healthy adults, whereas others are opportunistic pathogens able to infect only hosts with lowered immunity or sites other than their normal habitat. Some biohazardous materials are attenuated, or weakened, and do not produce significant disease. The more severe the potentially acquired disease, the higher the risks.

**Routes of Entry:** An infection occurs when pathogenic microorganisms enter the human body in sufficient numbers and by a particular route, which overcomes the body's defense system. By understanding the mode of transmission (pathway from source to you) and route of entry (entry route into body), procedures or controls to prevent exposure and infection can be developed.

**Inhalation hazards:** Inhalation of aerosolized biohazardous materials is the most common route of entry into the body. Inhalation of aerosols involves microscopic solid or liquid particles small enough to remain dispersed and suspended in air for long periods. Sources of aerosols include:

- Aerosolized solid material (spores, dust, particulate, etc.).
- Liquid material (mists and sprays, coughing, spittle, sputum, etc.).
- Technical process (blending, grinding, sonicating, lyophilizing, sawing, centrifuging, etc).

**Ingestion hazards:** Ingestion of biohazardous materials occurs frequently as the result of poor personal hygiene and poor laboratory practice. Proper hand washing minimizes the opportunity for mouth and eye exposures. Examples of how ingestion occurs include:

- Eating, drinking, and smoking in laboratory
- Mouth pipetting and suction techniques
- Transfer of microbes to mouth by contaminated fingers or articles

**Direct (Skin/Eye) Contact hazards:** Direct contact to biohazardous materials occurs through cross-contamination and mucous membrane exposure including the skin, eyes, inside of the mouth, nose, and the genitals. The main avenues by which biohazardous materials enter the body through the skin are hair follicles, sebaceous glands, sweat glands, and cuts or abrasions. Examples of how ingestion occurs include:

- Splash or spray of biohazardous material onto skin, eye, mouth, or nose
- Handling contaminated equipment with unprotected non-intact skin
- Transfer or rubbing by contaminated fingers or gloved hand
- Applying cosmetics or contact lens in laboratory

**Injection or inoculation hazards:** Inoculation or injection occurs when biohazardous material is accidentally introduced into the body with contaminated objects through the intact skin barrier. Inadequate control of sharp instruments and infected animals or arthropod vectors usually results in accidental inoculation or injection.

Examples of injection and inoculation hazards include:

- Inoculation with a hypodermic needle, broken glassware, scalpels, or other sharp instruments
- Sharps injuries (needle sticks, glass pipettes, syringes, etc.)
- Animal bites, scratches, kicks, abrasions, punctures

**Agent Stability or Viability:** Stability and viability refer to the ability of a biohazardous material to retain its biohazardous characteristics such as aerosol infectivity and survival time in environment. Factors such as temperature, humidity, pH, oxygen, sunlight or ultraviolet light, chemical disinfectants, growth factors (food reservoir or media), and competition with endemic organisms must be considered.

**Infectious Dose :** The infectious dose is the number of microorganisms required to initiate an infection. This dose can range from one to hundreds of thousands of units depending on agent, exposure route, virulence, and host immune status or susceptibility for the disease.

**Concentration (Amount of Agent):** Concentration is the number of infectious organisms per unit volume. As the viable agent concentration and volume increases, the risk potential gets higher. The media/reservoir, laboratory activity, volume (especially >10 liters) need to be considered in risk determination.

**Immune Status:** Immune status is the current condition of a living organism to resist and overcome infection or disease. The primary function of the immune system is to protect the body from foreign substances by an acquired ability to distinguish self from non-self. Host susceptibility or immune status helps determine the level of risk of acquiring a disease upon exposure. CDC and NIH guidelines presume a population of immunocompetent individuals.

#### **4.2.1 Laboratory Biological Safety Level Criteria**

ASU-Jonesboro, only allows two laboratory biological safety levels. The Biological Safety Levels consist of laboratory practices, safety equipment, and facilities combinations, which are specifically appropriate for the operations, performed, suspected routes of biohazardous material transmission, and laboratory function or activity.

##### Biological Safety Level 1 (BSL-1)

- Suitable for work involving well-characterized agents not known to consistently cause disease in healthy adult humans, and of minimal potential hazard to laboratory personnel and the environment.
- Special containment equipment or facility design is neither required nor generally used.
- Laboratory personnel have specific training in the procedures conducted in the laboratory.
- Supervision by a scientist with general training in microbiology or a related science.

##### Biological Safety Level 2 (BSL-2)

- Suitable for work involving agents of moderate potential hazard to laboratory personnel and the environment.
- Laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists.
- Access to the laboratory is limited when work is being conducted.
- Extreme precautions are taken with contaminated sharp items.
- Certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment.

<b>BSL</b>	<b>Agents</b>	<b>Practices</b>	<b>Safety Equipment (Primary Barriers)</b>	<b>Facilities (Secondary Barriers)</b>
1	Not known to consistently cause disease in healthy adults	Standard Microbiological Practices	None Required	Open Bench Top Sink Required
2	Associated with human disease, hazard = percutaneous injury, ingestion, mucous membrane exposure	BSL-1 practice plus: <ul style="list-style-type: none"> <li>Limited access</li> <li>Biohazard warning signs</li> <li>“Sharps” precautions</li> <li>Biosafety manual defining any needed waste decontamination or medical surveillance policies</li> </ul>	Primary Barriers = Class I or II BSCs or other physical containment devices used for all manipulations of agents that cause splashes or aerosols of infectious materials; PPE: laboratory coats, gloves and face protection is needed.	BSL-1 plus: Autoclave available

#### 4.2.2 Vertebrate Animal Biological Safety Level Criteria

There are two recommended vertebrate animal Biological Safety Levels. The recommendations below describe practices, safety equipment and facilities for experiments with animals infected with agents that cause, or may cause, human infection. In general, the Biological Safety Level recommended for working with biohazardous material in vivo and in vitro are comparable.

##### Animal Biological Safety Level 1 (ABSL-1)

- Suitable for work involving well-characterized agents not known to consistently cause disease in healthy adult humans, and of minimal potential hazard to personnel handling the animals and the environment.

##### Animal Biological Safety Level 2 (ABSL-2)

- This level involves practices for work with those agents associated with human disease. It addresses upon the practices, procedures, containment equipment, and facility requirements of ABSL-1.
- ABSL-2 is suitable for work involving agents of moderate potential hazard to laboratory personnel, animals, and the environment.
- Laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists.
- Access to the animal facility is limited to the fewest number of individuals possible. Personnel who must enter the room for program or service purposes when work is in progress are advised of the potential hazard.
- Certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment.

<b>ABSL</b>	<b>Agents</b>	<b>Practices</b>	<b>Safety Equipment (Primary Barriers)</b>	<b>Facilities (Secondary Barriers)</b>
1	Not known to consistently cause disease in healthy	Standard animal care and management practices, including appropriate medical surveillance programs.	As required for normal care of each species	Standard animal facility <ul style="list-style-type: none"> <li>No recirculation of exhaust air</li> </ul>

	adults			<ul style="list-style-type: none"> <li>• Directional air flow recommended</li> <li>• Hand washing sink recommended</li> </ul>
2	Associated with human disease; hazard = percutaneous exposure, ingestion, mucous membrane exposure	ABSL-1 practice plus: <ul style="list-style-type: none"> <li>• Limited access</li> <li>• Biohazard warning signs</li> <li>• “Sharps” precautions</li> <li>• Biosafety manual</li> <li>• Decontamination of all infectious waste and of animal cages prior to washing</li> </ul>	ABSL –1 equipment plus primary barriers: containment equipment appropriate for animal species; PPE: laboratory coats, gloves and respiratory protection as needed.	ABSL-1 facility plus: <ul style="list-style-type: none"> <li>• Autoclave available</li> <li>• Hand washing sink available in the animal room</li> <li>• Mechanical cage washer used</li> </ul>

### 4.2.3 Recombinant DNA Biological Safety Level Criteria

The following are NIH requirements for Campus Research with Recombinant DNA in humans, animals, and plants.

<http://www4.od.nih.gov/oba/rac/guidelines/guidelines.html>

(update: [http://oba.od.nih.gov/oba/rac/Guidelines/NIH\\_Guidelines.htm](http://oba.od.nih.gov/oba/rac/Guidelines/NIH_Guidelines.htm))

The investigator must make an initial risk assessment based on the Risk Group (RG) of an agent. Agents are classified into four Risk Groups (RGs) according to their relative pathogenicity for healthy adult humans by the following criteria:

- Risk Group 1 (RG1): agents are not associated with disease in healthy adults.
- Risk Group 2 (RG2): agents are associated with human disease that is rarely serious and for which preventive or therapeutic interventions are often available.

NIH Guidelines also address physical and biological containment for Recombinant DNA research involving humans, animals, plants and large-scale use, including standard microbiological practices, special practices, containment equipment and laboratory facilities. ONLY BSL 1 & 2 research activities are currently allowed on the ASU – Jonesboro campus.

- Biological Safety Level 1-4 (BL1 to BL4): standard research laboratory experiments.
- Biological Safety Level 1-4 Large Scale (BL1-Large Scale to BL4-Large Scale): large-scale (over 10 liters) research and production with Good Large Scale Practices (GLSP).
- Biological Safety Level 1-4 Plants (BL1-P to BL4-P): standard plant greenhouse facility experiments.
- Biological Safety Level 1-4 Animals (BL1-N to BL4-N): standard whole animal facility experiments.

## 4.3 Standard Operating Procedures

The following information represents a minimum set of guidelines for handling biohazardous material on campus. Individual administrative units, laboratories, or research groups are expected to develop more detailed procedures as appropriate. Other resources such as those listed in Section 4.3.5, and Appendix E may be useful in developing detailed procedures. The Environmental Health and Safety Department is available to consult and assist during individual safe procedure development for situations not covered in this guide.

### 4.3.1 General Procedures

Understand and respect the safety and health hazards associated with the biohazardous materials and equipment you use, and practice the following general safety guidelines at all times:

- **Accident response.** If an injury requiring emergency medical assistance occurs, call 9-911.
- **Autoclaves.** Personnel should only operate the autoclave after receiving proper instructions on operational procedures. Loosen caps of any containers prior to autoclaving. Open only when temperature and pressure are back to normal. Any leakage or release of contaminated materials should be reported to the PI or supervisor at once. Refer to Appendix G for specific information.
- **Biohazard releases.** If a biohazardous material makes contact with the skin, wash the area with soap and water immediately. If you suspect that a biohazardous material is aerosolized, hold your breath and leave the area immediately. If emergency assistance is required, call 9-911. Refer to Chapter 6 and Appendix I for additional information.
- **Biological Safety Cabinets.** Biological Safety Cabinets are primary containment devices that protect the personnel, immediate laboratory, and research and teaching environment from exposure to biohazardous materials. The Environmental Health and Safety Department (972-2862) must be contacted before the use of any new or relocated Biological Safety Cabinet to schedule certification. Refer to Sections 4.3.7 and Appendix J for specific information.
- **Blending, Grinding, Sonicating, Lyophilizing:** The greatest risk when using any of these techniques is the creation of aerosols. Blenders, grinders, sonicators, lyophilizers, etc. should be operated in a Biological Safety cabinet whenever possible. Safety blenders should be used. Safety blenders are designed to prevent leakage from the bottom of the blender jar and to withstand sterilization by autoclaving. They also provide a cooling jacket to avoid biological inactivation. Avoiding glass blender jars prevents breakage. If a glass jar must be used, it must be covered with a polypropylene jar to contain the glass in case of breakage. A towel moistened with disinfectant must be placed over the top of the blender while operating. This practice can be adapted to grinders and sonicators as well. Aerosols must be allowed to settle for five minutes before opening the blender jar (or grinder or sonicator container). Lyophilizer vacuum pump exhaust should be filtered through HEPA filters or vented into a biological safety cabinet. Polypropylene tubes



should be used in place of glass ampoules for storing biohazardous material in liquid nitrogen. Ampoules can explode, causing eye injuries and exposure to the biohazardous material.

- **Centrifuging:** The greatest risk with centrifuging is the creation of aerosols. Sealed tubes and safety cap buckets that seal with O-rings should be used. To avoid spills from broken tubes, the tubes, O-rings and buckets should be inspected for damage before each use. Leaks can be prevented by not overfilling centrifuge tubes. The outside of the tubes should be wiped with disinfectant after they are filled and sealed. Rotors and centrifuge tubes should be opened inside a biological safety cabinet. If a biological safety cabinet is not available, a minimum of 10 minutes settling time should be allowed before opening.
- **Children and unauthorized persons.** Children and other unauthorized persons are not allowed in laboratories where biohazardous materials are present.
- **Decontamination.** Work surfaces and equipment must be decontaminated immediately after using biohazardous materials. It is critical that the work area within biological safety cabinets always be cleaned and disinfected thoroughly, using a chemical disinfectant after each use.
- **Disposal of biohazardous materials.** Disposal procedures are described in Chapter 5 of this manual.
- **Electrical.** Access to electrical equipment (e.g., plugs, switches, and electrical panels) should be maintained at all times. Obstruction should never prevent immediate access in an emergency. Use polarized and grounded receptacle outlets in general laboratory areas and Ground Fault Circuit Interrupters (GFCIs) in wet or outdoor locations. Cords should not run in aisles or corridors, through doors, walls, partitions, under rugs, or above suspended ceilings.
- **Emergency eyewash and safety showers.** Be certain safety showers and emergency eyewash units are properly located, and maintained (reachable within 10 seconds). There should be no obstructions that might inhibit the use of this equipment. The Environmental Health and Safety Department will inspect eyewash and Safety showers on a weekly basis.
- **Equipment.** Use proper equipment that is in good condition. Never use chipped or cracked glassware. Shield pressurized or vacuum apparatus. Label contaminated equipment.
- **Fire extinguishers.** Appropriate type fire extinguishers must be available, charged, and mounted in a location that is immediately accessible (within 75 feet or as required by the Environmental Health and Safety Department and the Arkansas Fire Code). There shall be no obstructions that might inhibit the use of this equipment. Contact (870) 972-2862 for assistance.

- **Food, drink, cosmetics and contact lens.** Eating, drinking, and the application of contact lens or cosmetics are forbidden in areas where biohazardous materials are used. Food used for research should be labeled, "Not for Human Consumption".
- **Freezers and Refrigerators.** These should be checked and cleaned out periodically to remove any broken ampules, tubes, etc. containing toxic or infectious material. Use rubber gloves during this cleaning. Label all biohazardous or toxic material stored in refrigerators or deep freezers (refer to Section 4.3.8). Discard old specimens or samples when no longer needed.
- **Glass tubing.** When inserting glass tubing into stoppers, lubricate tubing and wear leather gloves to protect hands from tubing slips and breaks.
- **Horseplay.** Horseplay is prohibited in all research laboratories and work areas on the ASU-Jonesboro campus.
- **Housekeeping.** Exits, aisles, and safety equipment should not be obstructed. A minimum of 36 inches width must be maintained for laboratory aisles. Hallways are not to be used as storage areas.
- **Inoculating Loop Sterilizing.** The greatest risk when sterilizing inoculating loops in an open flame (such as with a Bunsen burner) is the creation of aerosols, which may contain viable microorganisms, and flammable material work. A shielded electric incinerator or hot bead sterilizer should be used to minimize aerosol production. Disposable plastic loops and needles are good alternatives.
- **Open Flames in Biological Safety Cabinets.** Open flames, such as Bunsen burners, should never be used in biological safety cabinets (BSC). Open flames inside of a BSC disrupt the airflow, compromising protection of both the worker and the work. Open flames are extremely dangerous around flammable materials, such as ethanol, which is often found in a BSC. Electric incinerators or disposable inoculating loops can be used instead.
- **Personal hygiene.** Hands should be washed frequently, even after wearing gloves, and scrubbed vigorously with soap and water for a full 30 seconds. The physical removal of organisms from the skin is just as important as using a disinfectant. Contaminated hands should be kept away from the mouth, eyes, nose, and non-intact skin.
- **Pipetting.** The greatest risks with pipetting are the creation of aerosols and splashing. Mouth pipetting is prohibited. Mechanical pipetting aids should be used instead. All biohazardous materials should be pipetted in a Biological safety cabinet if possible. Cotton-plugged pipettes should be used. Biohazardous materials must never be forcibly discharged from pipettes. "To deliver" pipettes should be used instead of pipettes requiring blowout. To avoid splashing, biohazardous material should be dispensed from a pipette by allowing it to run down the receiving container wall. After using reusable pipettes, they should be placed horizontally in a pan filled with enough liquid disinfectant to completely cover them and the entire pan autoclaved before cleaning the pipettes for reuse.

- **Security.** Access to biohazardous materials shall be limited to authorized personnel only. The control of biological hazards shall be maintained by securing and locking the laboratory when unattended by authorized personnel and during all off-hours. During transportation between laboratories, biohazardous materials must be properly packaged and must not be left unattended or unsecured. Refer to Appendix K for specific information.
- **Sharps, Needles, and Syringes.** The greatest risks when using sharps are accidental injection and the creation of aerosols. Needles and syringes should only be used when there is no reasonable alternative. Safety needles and syringes should be used in these instances. The sharp should be kept away from the fingers as much as possible. Sharps should never be bent, sheared, recapped, nor have needles removed from syringes after use. If a contaminated needle must be recapped or removed from the syringe, a mechanical device, such as a forceps, must be used. Air bubbles should be minimized when filling a syringe. A pad moistened with disinfectant must be placed over the tip of the needle when expelling air. Work should be performed in a Biological safety cabinet whenever possible. An appropriate sharps container must be kept close to the work area to avoid walking around with contaminated sharps. Care should be taken not to overfill sharps containers. They are considered full when they are 2/3 filled. Refer to Section 4.3.5, 5.2 and Appendix H for specific information.
- **Smoking.** Smoking is prohibited within all University facilities. A burning cigarette, cigar, or pipe is an ignition source to flammable solvents. The handling of chewing tobacco, cigarettes, cigars or pipes from bench to mouth is a potential route of transmission for microorganisms and toxic material. Wash hands before smoking whenever biohazardous materials are handled.
- **Spill preparedness.** Before working with biohazardous materials, assess potential spill or release hazards. Become familiar with the general spill response procedures (refer to Chapter 6). Be sure the Laboratory Biological safety Spill Kit/Station and Emergency Notification Signage is current, available and maintained.
- **Unattended experiments.** Avoid unattended experiments. If biohazardous material operations are carried out with no one present, it is the responsibility of the worker to design and prevent accidental release in the event of interruption in utility services. Appropriate arrangements should be made for periodic inspection of the operation.
- **Universal Precautions.** All blood or Other Potentially Infectious Materials (OPIM) will be considered infectious regardless of the perceived status of the source individual. These precautions will be observed at the University to prevent contact with potentially infectious materials. Refer to Sections 2.2, 4.3.4, 4.3.5 and Appendix E for specific information.

### 4.3.2 Personal Protective Equipment

Wearing appropriate personal protective equipment and practicing good personal hygiene will reduce exposure to biohazardous materials during routine use, and in the event of an accident.

- **Attire.** Wear a laboratory coat or apron. If shorts or skirts are worn, the lab coat must be knee length or longer. Wear closed-toe shoes (no sandals). Confine loose clothing and long hair. Nylons or pantyhose are not recommended because they may melt upon contact with acid or heat source. Hands and arms must be covered when using UV light sources.
- **Eye Protection.** All personnel including students, staff, and visitors must wear approved safety glasses or goggles at all times where eye hazards are a possibility. Goggles are recommended when biohazardous splashes or releases are possible. Proper UV shielded safety glasses must be used with UV light sources. Contact lenses may be worn in the laboratory. However, they do not provide any protection for the eyes. Persons who wear contacts must use the same eye protective equipment as those who do not wear contacts.
- **Face Shields.** Full-face shields must be worn when conducting a procedure, which may result in a violent reaction, spray or splash. Full-face shields with bottom caps to protect the neck are preferred as they provide the best protection.
- **Gloves.** Gloves are essential when working with biohazardous materials and observing universal precautions. The proper gloves will prevent skin absorption, contamination, infection, and burns. Disposable gloves (nitrile, latex, etc.) usually provide adequate protection against exposure to biohazardous materials, but rarely provide adequate protection to hazardous materials. Consult a glove manufacturer or contact the Environmental Health and Safety Department at 972-2862 for assistance in appropriate glove selection.
- **Respiratory Protection.** Use a biological safety cabinet to ensure adequate ventilation when working with biohazardous materials that may produce aerosols. If the use of an approved respirator with HEPA cartridges is required, you must comply with the University Respiratory Protection Program, which includes an initial medical assessment, annual fit testing and instructions on proper use. Contact the Environmental Health and Safety Department at 972-2862 for assistance.

### 4.3.3 Risk Assessments

The purpose of the risk assessment is to reduce potential hazards during acquisition, use, and storage of biohazardous materials. The Principal Investigator/Supervisor has responsibility for making the risk assessment and controlling the potential hazards associated with biohazardous materials. This should be done in close collaboration with the Institutional Biological safety Committee and the Environmental Health and Safety Departments. A written risk assessment must be conducted for each research protocol involving suspect biohazardous materials.

The "**Biohazardous Materials Risk Assessment Checklist**" below is a practical guide to risk assessment resources. Risks need to be assessed prior to acquisition, use, storage and disposal of biohazardous materials.

	<p><b>Obtain IBSC approval for your research protocol and register with the Environmental Health and Safety Department as a Registered User</b> (see Chapter 3). Complete the Biohazardous Material Application Form (Appendix A), which will be used in collaboration with the Institutional Biological safety Committee and the Environmental Health and Safety Department.</p>
	<p><b>Classify your biohazardous materials.</b> Use the information resources in Section 2.3 and provided by the manufacturer or biohazardous material source. Identify and understand the risk factors associated with the specific biohazardous material used. This information should be interpreted for its tendency to raise or lower the risk of laboratory-acquired infection. Factors to be considered include, but are not limited to: agent identity and origin, virulence, pathogenicity, infectious dose, environmental stability, route of transmission and entry, communicability, operations, quantity, concentration, animal studies, availability of vaccine or treatment, and gene product effects such as toxicity, physiological activity and allergenicity. Refer to Section 4.2 "Biological Safety Principles and Concepts" for risk factor definitions.</p>
	<p><b>Use Appendix B to develop a Biohazardous Laboratory Job Safety Analysis/Protocol.</b> This is a systematic review to visualize the operational use, handling, and storage process of the specific biohazardous material(s) within the laboratory and identification of the associated hazards. Tasks involving similar hazards may be grouped together.</p>
	<p><b>Use Section 4.2.1 to determine the appropriate Laboratory Biological Safety Level Criteria.</b> Review the primary and secondary containment requirements. Appendix C provides additional detail on general laboratory containment needs.</p>
	<p><b>Use Section 4.3.5 to prepare your Laboratory Specific Exposure Control Plan.</b> The laboratory specific exposure control plan is used by the Principal Investigator or Supervisor and laboratory personnel to reduce the risk of laboratory-acquired infection(s). Appendix D contains a Biological safety Laboratory Self-Inspection Checklist to help laboratory workers stay on top of compliance with safety protocols.</p>
	<p><b>Acquire biohazardous materials in accordance with campus procedures</b> (Section 3.3).</p>
	<p><b>Use biohazardous materials in accordance with the guidance presented in Section 4.3.6 and your laboratory specific protocols.</b></p>

#### 4.3.4 Blood Borne Pathogens and Universal Precautions

University faculty, staff and students may be at risk of exposure to blood borne pathogens such as hepatitis B (HBV), hepatitis C, and human immunodeficiency virus (HIV). Universal precautions and the laboratory specific exposure control plan are measures that promote University worker protection.

The concept of "Universal Precautions" refers to the treatment of all potentially infectious blood or body fluids as if known to be infectious. These precautions are observed at ASU for all human blood, blood products, certain body fluids (semen, vaginal, cerebrospinal, synovial, pleural, peritoneal, pericardial, and amniotic), body fluids with visible blood, unfixed human tissue or organ, animal blood and tissue with known zoonotic disease or unknown sources. This laboratory infection control method will help prevent laboratory-associated infections and spread of communicable disease.

The simple "ABCDE's" of laboratory infection control are:

- **A**void contact with potentially infectious materials (Protective gloves, glasses, lab coat & HEPA respirator).
- **B**e prepared with the proper supplies and equipment (Biological safety spill kits, safety equipment, etc.).
- **C**lean and sanitize contaminated surfaces with a proper disinfectant.
- **D**ispose or treat biohazardous waste, sharps, contaminated clothing, etc. properly.
  - **E**very time, remember to wash your hands well and no eating, drinking, smoking, etc. in laboratory.

#### 4.3.5 Laboratory Specific Exposure Control Plan

Each Principal Investigator and Supervisor should review and prepare a specific Exposure Control Plan for their laboratory. The Laboratory Specific Exposure Control Plan is a reference and guide for all personnel who may be exposed to biohazardous materials. A template is presented in Appendix E. Completed Laboratory Specific Exposure Control Plan shall be forwarded to the Environmental Health and Safety Department. The Laboratory Specific Exposure Control Plan elements listed below are used to reduce exposure to blood borne pathogens, biohazardous materials and lab-acquired infections.

- Review work assignments to determine employee potential for exposure to lab-acquired infections.
- Identify responsibilities of employees covered by the Exposure Control Plan
- Universal precautions and specific measures on how to minimize the risk of exposure
- Engineering Controls - Biological safety cabinet, centrifuge safety cups, sharps containers, etc.
- Work practices - hand washing, personal hygiene, labeling, sharps handling, etc.
- Personal Protective Equipment (PPE) - gloves, lab coat, safety glasses, HEPA mask, etc.
- Housekeeping - cleaning, decontamination and removal of unwanted materials.
- Laboratory Specific Emergency Plan should there be an exposure or release.
- Exposure Incident Reporting and Record keeping.
- Training - Initial and Refreshers.

### 4.3.6 Handling and Storage of Biohazardous Materials

Hazards associated with biohazardous materials vary widely. Understanding the hazards associated with a biohazard and reducing the quantity used and stored in the lab will decrease the chance of injury.

- **Containers.** Verify the integrity of all containers. If deteriorated containers are found, dispose of the biohazard promptly or transfer it to a properly labeled new container. Make sure that the container is appropriate for the biohazard being stored. Example: some biohazards are stored as a liquid and if frozen, the container needs to adequately contain the expansion of the liquid and not leak after thawing.
- **Transferring.** Provide completely sealed secondary containment for all biohazardous material when transferring between work areas. This will prevent release and aerosolizing of the biohazard in the event of an accident.
- **Inventory.** Inventories should be reviewed on a monthly basis to identify deteriorating biohazardous materials before problems develop with the material or containment. Avoid excess purchases, growth or stockpiling of biohazardous material. Maintaining up-to-date inventories improves emergency response capability, assists Environmental Health and Safety and the IBSC with activities such as biohazard waste determinations and safety reviews, and allows principal investigator or supervisor to maintain accountability and security of biohazardous material within laboratory.
- Registered Users are required to maintain and submit an annual inventory to the Environmental Health and Safety Department of biohazardous material for recombinant DNA and Biological safety Level 2 research activities, Select Agents, High Consequence Livestock Pathogens or Toxins, and others as determined by regulatory requirements.
- **Labels.** Make sure all labels are legible. Label all containers of biohazardous materials with the complete name, date, origin (human, animal or plant source) and rDNA information, if applicable. Refer to Section 4.3.8 for specific information.
- **Storage.** Avoid storing biohazardous material containers in hard to reach areas. Containers larger than one gallon should not be stored above shoulder height. Biohazardous materials should be segregated by classification and stored alphabetically. Laboratories with large numbers of biohazard classifications may choose to further segregate these hazards. Biological safety Cabinets are not designed for the storage of chemicals or biohazardous materials.

### **4.3.7 Biological Safety Cabinets and Other Engineering Controls**

Biological Safety cabinets and other engineering controls should be inspected annually for proper operation by a qualified person from the Environmental Health and Safety Department, or an approved qualified person or outside contractor. A written report of the results must be kept on record by the unit in charge of the laboratory. In most cases, the Department or PI is responsible for the cost of maintenance and annual certification for biological safety cabinets. Biological Safety cabinets are not designed to control chemical exposures. If you wish to use a hazardous chemical in a biological safety cabinet, contact the Environmental Health and Safety Department to assess potential hazards and assist in developing safe procedures.

Engineering controls, protective equipment, biological safety cabinets and laboratory hoods should be checked periodically by the Registered User to ensure that the equipment is functioning properly. The office of Environmental Health and Safety will assist upon request. Any questions or requests for assistance in evaluation of biological safety cabinets, fume hoods, or other protective equipment maybe directed to Environmental Health and safety (972-2862). Refer to Appendix J "Biological Safety Cabinet Summary Chart".

#### **4.3.7.1 What are Biological Safety Cabinets and Laminar Flow "Clean Benches"?**

Biological Safety Cabinets have been divided into three classes (Class I, II, and III) based on primary containment capability, design, and cleanliness. Class I and II cabinets are partial containment devices with an air barrier between the operator and biohazard work area. Class III cabinets are "absolute" containment devices with a physical barrier between the operator and biohazard work area.

Laminar Flow "Clean Benches" are not primary or secondary containment devices. They provide the horizontal or vertical positive pressure flow air environment for product protection only. The horizontal flow clean benches are used in clinical, pharmaceutical, and laboratory facilities without toxic, infectious, radioactive, or sensitizing materials. The vertical flow clean benches are useful for certain manipulations of clean materials (e.g. pouring agar plates, etc.) but must not be used for personal protection.

Note: All Biological safety Cabinets and Laminar Flow (Clean benches) that use an Ultraviolet (UV) lighting source are required to have a visible warning label that states a UV light source is in the cabinet and should not be on while occupants are in the laboratory. Refer to Section 4.3.8.2 for specific information.

#### **4.3.7.2 Biological Safety Cabinet Certifications**

All Biological safety Cabinets are required to have an annual inspection and certification, if used for primary containment and personal protection with biohazards. Biological Safety Cabinets must be certified when moved or repaired. It is also recommended that all Laminar Flow "Clean Benches" be certified annually to assure product protection capability.



Annual certifications cover, but are not limited to, the following inspection areas: Down Flow Velocity and Volume; Inflow Velocity (Face Velocity); Airflow Smoke Test; HEPA Filter Leak Test; Electrical Leakage; Ground Circuit Resistance and Polarity; Lighting Intensity; Cabinet Leak Test; Vibration, and Noise Level; and Record of Field Certification. After successful inspection completion, certification labels should be placed on the Biological Safety Cabinet or Laminar Flow "Clean Benches".

#### **4.3.7.3 Safety Procedures for Biological Safety Cabinets**

- The researcher should wear a closed-front lab coat (or surgical gown) and gloves.
- The gloves should overlap the lab coat or surgical gown cuffs.
- All handling materials should be placed in the cabinet before initiating biohazard work, to minimize in-and-out motions.
- Do not cover or obstruct the air intake grill.
- All biohazard work should be at least four inches in front of the cabinet's front grill.
- When a biological safety cabinet is in use, the lab entry door must be kept closed and traffic minimized.
- Do not use electric fans in the room when the biological safety cabinet is operating - this will seriously affect airflow.
- Develop unwanted materials collection and decontamination procedures to avoid clutter and minimize in-and-out motions
- Decontaminate the cabinet with an appropriate disinfectant at the end of each operation.

#### **4.3.7.4 Other Engineering Controls**

- Laboratory Hood (Hazardous and Radioactive Material Use) and Canopy Hood
- Glove Boxes, Autoclaves, Incinerators, Sharps Container, UV Fluorescent Lamps
- Centrifuge w/ O-rings Sealed Lids, Sealed Tubes & Safety Cap Buckets
- Safety Blenders (designed to prevent jar bottom leakage/withstand sterilization by autoclaving)
- Lyophilizer Vacuum Pump Exhaust w/ HEPA filters, Enclosed Incubators and Fermentors
- Open Bench Top Sink and Separate HEPA Filter Ventilation System
- Negative Pressure Rooms, Sealed Floors, Walls, Windows, Ceilings and Doors
- Airlocks or Liquid Disinfectant Barrier, Change/Shower Rooms
- Mechanical Animal Cage Washer, Waste Water Disinfectant System
- 24-Hour Limited Security Access, Pest/Vector-proof Design

#### **4.3.8 Biohazard Warning Signs and Labels**

Anyone entering areas where biohazardous materials are used or stored must be aware of the potential hazards. The biohazard symbol must be on all entries to biohazardous material laboratories, containers, biological safety cabinets, infectious waste containers, freezers, refrigerators and other equipment where blood and other potentially infectious materials are used or stored.

Signs - Post permanent area warning signs in a visible, legible, entry location for all laboratory occupants and visitors. Post temporary signs (less than one month) with tape on glass surfaces or on refrigerators, freezers, or entry doors. Remove all temporary signs when the hazard no longer exists. Entry door signs may be requested from the Environmental Health and Safety Department. Refer to Appendix L for illustration of the University Biohazard Warning Signs.

- Human biohazard signs (red) should be posted on doors to rooms where microorganisms or biological toxins known to cause disease in humans are used, such as microorganisms classified to be used in Biological Safety Level 2 research activities.
- Animal biohazard signs (yellow) should be posted where strict animal pathogens are used.
- Plant biohazard signs (green) should be posted where strict plant pathogens are used.

**Note:** These Biohazard Warning Signs (Appendix L) are in addition to the Emergency Notification Sign posting required for all laboratories on the ASU – Jonesboro Campus.

Labels - Affix labels with appropriate warnings to all biohazardous material in addition to the required area sign designation referred to above. Red or orange biohazard labels should be placed on containers, biological safety cabinets, and storage units (refrigerators, freezers, incubators, waste containers, etc.) that are used for biohazardous materials. Contaminated equipment must be labeled as well. Refer to Section 4.3.8.1 below for specific requirements.

#### **4.3.8.1 Biohazardous Material Container Labels**

All biohazardous agents and materials must be labeled with the following information:

- Content (Name of Biohazardous Material) and Volume
- Origin (human, animal or plant source and rDNA information if applicable)
- Concentration (# organisms/volume, #viable colonies/volume, etc.)
- Dates (received, prepared, placed in service)
- "Caution Required" and Biohazard Symbol
- Type of Hazards (i.e. inhalation, skin contact, etc.)
- Precautions and Controls (i.e. avoid skin contact)
- Accident Instructions (i.e. wash immediately, etc.)

#### **4.3.8.2 Ultraviolet (UV) Fluorescent Lamp Labeling Requirements**

The use of UV radiation fluorescent lamps (180-400 nm wavelength) may produce acute adverse effects such as corneal injuries (welder's flash), erythema, photokeratitis, and lens cataracts. Appropriate UV lamp warning labeling must state: "CAUTION Ultraviolet Radiation - Protect Eyes and Skin". The UV lamp room warning sign must state, "CAUTION Ultraviolet Radiation - DO NOT ENTER AREA WHILE UV LAMPS OPERATING". Appropriate personal protective equipment (PPE) would include safety glasses w/ proper UV filters, and UV hand and arm covering at a minimum. All UV exposures should not

exceed the ACGIH TLVs for occupational exposure to UV radiation incident upon the skin or the eye in an 8-hour period without PPE. Refer below to the UV lamp use applications of biological safety cabinets w/UV lamps, single UV lamp fixture (above lab bench), and UV lamp room:

**Biological Safety Cabinets (BSC) w/ UV lamps:** use in accordance with manufacturer's guidelines. Assure that "older" BSC have the UV lamp warning labeling and the labeling is legible. The principal investigator is responsible to maintain, certify, label, provide PPE and UV hazard training for all exposed to the BSC w/ UV lamps (laboratory and Campus Facilities staff).

**Single UV Lamp Fixture:** install and use fixtures and lamps in accordance with manufacturer recommendations and NEC guidelines. Assure that the UV lamp fixture has the UV lamp warning labeling and the labeling is legible. The principal investigator has the responsibility to maintain, label, provide PPE and UV hazard training for all exposed to the single UV lamp fixtures. Supervisors are responsible for providing PPE and UV hazard training for all staff working on single UV lamp fixtures.

**UV Lamp Room:** install and use fixtures and lamps in accordance with manufacturer recommendations and NEC guidelines. Assure that the lamp fixture has the lamp warning labeling and the labeling is legible. Post the UV lamp room warning sign on all entrance doors. Verify no room occupancy and lock all entry doors prior to operating the UV lamp room. The principal investigator is responsible to maintain, label, provide PPE and UV hazard training for all exposed to the UV lamp room or single lamp fixtures. Supervisors are responsible for providing PPE and UV hazard training for all staff working on UV lamp fixtures or rooms.

### 4.3.9 Special Provisions for Select Agents and Biological Toxins

In addition to the general safety guidelines, mentioned above, special precautions are required when handling select agents and biological toxins, high consequence livestock pathogens or toxins, and plant pathogens with a high degree of acute toxicity. The Registered User should ensure that precautions designed to minimize risk of exposure to these substances are taken. Refer to Appendix A-4 for listing. The following are minimum guidelines:

- Report any newly identified select agents or toxins, high consequence livestock pathogens or toxins and plant pathogens immediately to the Environmental Health and Safety Department.
- Quantities of select agents or toxins should be minimized, as should their concentrations such as in cultures, broths, or lyophilizing these select agents and biological toxins.
- Using work practices that block routes of exposure can prevent workplace infection. Good microbiological techniques must always be used in the laboratory.
- Each laboratory using these substances must designate an area for this purpose, sign or mark this area with an appropriate hazard warning such as a Biohazard Warning Sign. Refer to Appendix L for illustration of the specific Biohazard Warning Signs (Human, Animal and Plant).
- All laboratory workers and ancillary workers in a laboratory with an area designated for use with select agents, biological toxins, and acutely toxic chemicals must be trained in the harmful effects of these substances. This should include recognizing signs and symptoms of exposure. Training to safely handle and store these substances is required for those who use or may potentially be exposed to these materials. This training is the responsibility of the Registered User or Principal Investigator and must be done prior to the use of any of these materials.
- Laboratory workers using these select agents and biological toxins must have access to appropriate personal protective equipment (available at no expense to the worker) and must be trained to properly use this equipment.
- Detection equipment may be required if acutely toxic chemicals are used with biohazardous material.
- All unwanted chemical hazardous materials containing biohazardous material should be collected and disposed of promptly as outlined in Chapter 5. The designated working area must be thoroughly decontaminated and cleaned at regular intervals that are determined by the Principal Investigator. The interval may be as short as every few minutes to as long as one day depending upon the frequency of usage and the level of hazard.
- Special precautions are required to avoid release and exposure of biohazardous materials. For instance, pipetting liquid biohazardous agents should always be conducted in a certified Biological Safety cabinet. Needles should never be recapped due to the high risk of punctures.
- Emergency response planning for biohazardous releases or spills should be prepared by the Principal Investigator and be included in the training of the laboratory workers and others in the building who may be affected. Refer to Chapter 6 for Emergency Response information.

## **Chapter 5**

### **BIOHAZARDOUS UNWANTED MATERIALS MANAGEMENT**

This chapter describes management of Biohazardous Unwanted Materials. Use of proper sterilizing and disinfecting methods should be the primary treatment techniques for deactivating and disposal of biohazardous material as regular solid waste. If you suspect that a proposed activity might produce biohazardous materials that are difficult or expensive to dispose, or have, multiple hazards (biohazard, chemical, radioactive) contact Environmental Health and Safety for guidance before conducting your activity.

#### **5.1 Biohazardous Unwanted Materials Description**

Biohazardous unwanted material and products that have not been rendered innocuous or determined noninfectious by the Principal Investigator or their authorized representative should be considered infectious. These include:

- Blood and blood products - human blood, blood products (serum, plasma and other blood components) and body fluids.
- Sharps - needles, syringes, scalpels and glass vials
- Microbiologicals - including all cultures and stocks of infectious agents
- Pathologicals - including tissues, organs, and body parts discarded from surgical, obstetrical, autopsy and laboratory procedures.
- Broken glass that can be properly decontaminated should not be placed in the Biohazardous Unwanted Materials system.

#### **5.2 Biohazardous Unwanted Materials Disposal Policies**

Biohazardous unwanted materials that have not been sterilized must be disposed by Environmental Health and Safety Department or a biohazardous waste disposal vendor approved by Environmental Health and Safety. Biohazardous unwanted materials must be properly labeled, packaged, and stored prior to transport.

**Packaging and Labels** -- Packaging and labels will be provided by Environmental Health and Safety or their authorized biohazard waste disposal vendor, with the exception of special packaging for articles that could potentially puncture bags or boxes.

- Articles that could puncture bags or boxes ("sharps") must be placed in puncture-proof containers available from Environmental Health and Safety (972-2862), or from commercial sources. The containers can then be picked up separately (if liquid-free) or placed in the bags and boxes provided. Refer to Appendix H for specific information.
- All biohazardous materials including diagnostic specimens and biological products must be packaged to prevent leakage of contents during handling and transportation. Leaking containers or improperly packaged sharps will not be accepted by Environmental Health and Safety or authorized biohazardous waste vendors.
- Label all containers of biohazardous waste with the date when accumulation begins. There is a biohazard label available from Environmental Health and Safety for this information.

**Segregate biohazardous material from unwanted chemical and radioactive materials:** multiple hazard (biohazard, chemical, radioactive) segregation must consider all potential hazard classifications. Contact the Environmental Health and Safety Department for assistance.

**Use compatible containers and closures:** Containers for biohazardous material must be of good condition and not react with other hazardous materials they may hold.

**Good housekeeping:** Good housekeeping is the most important action to improve safety and minimize waste. Clean up spills and releases promptly and thoroughly using approved methods.

**Collection:** Collection from individual laboratories is arranged by contacting Environmental Health and Safety (972-2862).

**Training:** Training on handling and disposal of biohazardous unwanted materials is provided free of charge by Environmental Health and Safety to University Faculty and Staff. To schedule training, please contact Environmental Health and Safety at 972-2862.

### 5.3 Biohazardous Material Laboratory Closure

Principal Investigators/Supervisors where biohazardous materials for rDNA or Biological Safety Level 2 research activities are used must complete a proper Biohazardous Material Laboratory Closure prior to terminating biohazardous material use. This will ensure proper transfer or disposal of all biohazardous materials, decontamination of any remaining contaminated items, accurate inventory records, and removal of biohazard signs/labels. Environmental Health and Safety approval is required prior to release of laboratories for unrestricted use.

The following procedure provides steps for proper Biohazardous Material Laboratory Closure:

- Contact the Environmental Health and Safety Department 972-2862 to discuss plans for changes or termination of activity (provide as much advanced notice as possible).
- Properly sterilize, dispose or transfer all remaining biohazardous material when all biohazardous material work has been completed in your approved area. Shared storage areas must be carefully reviewed by departing and sharing researchers to identify biohazardous material ownership.
- Decontaminate, clean and sanitize all potentially contaminated laboratory surfaces, equipment and fixtures (after a thorough survey to identify all rooms and equipment).
- Contact Environmental Health and Safety 972-2862 to arrange for pick-up and disposal of Biohazardous Unwanted Materials that have not been sterilized.
- Schedule a closure survey with the Environmental Health and Safety Department. All labeled equipment; lab ware, fixtures, areas and rooms must be surveyed and de-labeled or de-posted before Environmental Health and Safety will release for unrestricted use.

Note: Radiation Safety and Hazardous Materials Management have similar inactivating, decommissioning, transfer, and change notification requirements for use of radioactive material and hazardous material, respectively. Refer to the Radiation Safety Manual and Hazardous Materials Management Manual for specific requirements.

## **Chapter 6**

### **BIOHAZARD EMERGENCY RESPONSE PROCEDURES**

This chapter is the biohazard emergency response guide for laboratory personnel at ASU.

#### **6.1 INTRODUCTION**

Principal Investigators, laboratory supervisors, laboratory biological safety officers, and workers should use this document as a reference, to reduce the risk of exposure from a spill or release of Biological Safety Level 2 agents in their laboratory. For agents that have a higher level of risk please contact the Environmental Health and Safety Department. At this time, only BSL 1 and BSL 2 activities are permitted.

Section 6.2 is a list of actions that must be preformed immediately and reviewed routinely, by all laboratory staff. Section 6.3 is a response guide that should be used as a reference during laboratory personnel training and for emergency preparedness activities.

#### **6.2 IMMEDIATE BIOHAZARD EMERGENCY RESPONSE**

##### **6.2.1 Immediate Emergency Response Actions**

If you drop, become aware of, or otherwise release a container of microorganisms:

- Leave the room. Close the door behind you. Call for assistance: Environmental Health and Safety (972-2862) days, (897-1574) nights/weekends, University Police (972-2093) nights, weekends and holidays.
- Access the biological safety kit/station outside the laboratory.
- Remove and place contaminated protective garments (including shoes) into a red biohazard bag at the door immediately after exiting.
- Place a warning sign on the door handle and isolate the area.
- Wash hands and face or, if facilities are available, shower. Use germicidal soap.
- Notify the supervisor responsible for the area immediately using emergency contact information on lab entry door.

##### **6.2.2 Follow-up Response and Disinfection Actions**

When the above immediate actions are accomplished, disinfection and clean-up will be directed by the supervisor responsible for the area.

- Before reentering the affected area, wait a minimum of 30 minutes to permit reduction of airborne particles by ventilation changes. Verify the biological safety cabinet is operational.
- Review available protective equipment/materials, biological safety kit/station, and personnel resources. Develop and communicate response and decontamination clean-up plans.
- Use appropriate disinfecting solution (example: 1 part household bleach (5.25% sodium hypochlorite) and 9 parts water) to treat the spill area. To minimize aerosols, do not spray the disinfectant. Pour it gently, directing its flow into the spill area. Cover the area with absorbent paper or cloth. Allow 20 minutes of contact time.

- Using an autoclavable (or expendable) dustpan and squeegee, transfer all materials from the spill area to a deep autoclave pan including, finally, the dustpan and squeegee. Cover the pan with foil or other means for transfer to an autoclave. Remove the rubber gloves worn to that point, leave in the autoclave and don a fresh pair.
- Wash and mop the spill area and adjacent areas with disinfecting-detergent solution.
- Before leaving the immediate area, wash rubber boots with disinfectant solution, remove and bag respirator(s) (separately) and then remove cap, gown, and rubber gloves for appropriate disinfection or autoclaving. The boots should be exchanged for conventional disposable booties before leaving the area.
- The Supervisor shall be responsible for ensuring that all unwanted materials, equipment, and clothing are properly disinfected and accounted for. Replenish biological safety kit/station and used resources (gloves, garments, disinfectants, etc.) for future use.

### **6.2.3 Airflow and Power Failures of Biological Safety Cabinets**

If airflow in a biological safety cabinet changes abruptly or the power fails more than momentarily while working with BSL-2 agents the following procedures are recommended:

- Terminate working with the agent, taking care not to create aerosols.
- Leave the laboratory and assure that others have also left.
- Secure the laboratory from entry by other personnel.
- If the agent poses a health hazard to humans, contact the Environmental Health and Safety Department (972-2862) or University Police Department (972-2093).
- When power is restored wait 30 minutes to reduce airborne particles, verify the operation of the biological safety cabinet, then disinfect the work area as necessary based on the activity that was in progress. Consult with the Safety Professional if there are any questions.
- Replenish Biological Safety kit/station and used resources (gloves, garments, disinfectants, etc.) outside the laboratory for future use.

## **6.3 DETAILED BIOHAZARD EMERGENCY RESPONSE**

### **6.3.1 General Comments on Emergencies**

NIH Guidelines require the preparation of emergency plans for laboratories and facilities involved in biohazard activities. It is the laboratory Principal Investigator or supervisor's responsibility to:

- Develop and communicate specific emergency plans for their laboratory.
- Post and update emergency notification signage.
- Maintain a Biological Safety kit/station outside the laboratory.

Principal Investigators or supervisors are responsible for training laboratory personnel in laboratory emergency procedures and how these procedures should be followed in their specific area. The following basic principles are useful in developing specific procedures for dealing with accidental spills or releases of biohazardous material:



- Render assistance to persons involved.
- Warn personnel of the potential hazards to their safety and evacuate the area if necessary.
- Control area to allow only authorized persons to enter. Do not allow re-entry to the area without proper controls/training or until hazards are eliminated. The incident commander, principal investigator, biological safety professional and other expert personnel will determine re-entry procedures.

### 6.3.2 Reporting of Biohazard Emergency Incidents

#### Biohazard Emergency Accidents

Examples:

- Fatality
- Hospitalization or medical treatment
- First aid treatment
- Fire, explosion and/or personal exposures/injuries
- Property damage
- Biohazard exposure/accidental release of biohazard material

If an accident occurs:

1. Call for assistance:  
**Ambulance (9-911)**  
**ASUPD (972-2093)**  
**ENVIRONMENTAL HEALTH AND SAFETY DEPARTMENT (972-2862 or 897-1574)**

The following information should be provided:

- Where and what type of incident has occurred.
  - Assistance needed.
  - Nature and type of any injured persons.
  - What has happened since the incident: e.g., building evacuation has been started, etc.
  - Identity of caller and location from which he/she is calling, and who and where someone will be to meet and assist response personnel upon their arrival.
2. Report as soon as possible to the Principal Investigator (PI) or supervisor. If not available, report to the acting PI or supervisor in their absence.
  3. Students who have a non-emergency injury or made ill because of a biohazard activity should report to the Student Health Center.
  4. Each person involved in or supporting biohazard work shall report to his/her PI or supervisor: - Each spill, release, near-miss incident, accident, etc.
    - a. Each unsafe condition observed having the potential for injuring or endangering the health of people and/or causing damage to property.
  5. All external reports, other than those of an immediate nature such as summoning the fire department in case of a fire, are made by or through the Environmental Health and Safety Department (972-2862).

## **6.3.3 Biohazard Emergency Response Procedure**

### **6.3.3.1 Introduction**

All biohazardous equipment, facilities, residue, or other material must be properly disinfected, contained, secured, and transported in a safe manner. The laboratory PI or supervisor is responsible for preplanning immediate actions and decontamination procedures to cope with a biohazard release through preparation of a Laboratory Specific Exposure Control Plan (Section 4.3.5). Preplanning includes, but is not limited to:

- Laboratory area and program survey
- Development of laboratory specific emergency plans
- Provide and maintain a biological safety kit/station (refer to Appendix I)
- Training of laboratory personnel in emergency response procedures

### **6.3.3.2 Laboratory Area and Program Survey**

The Laboratory Area and Program Survey includes the following elements:

- A written assessment providing information on exposure prevention of personnel, environment, and property, with preparations to contain and disinfect the release.
- Types and levels of potential research program risks.
- Decontamination practices must be established for the type of biohazards involved and type of disinfectant needed for the biohazardous material.
- A good understanding of the air handling systems such as: HVAC units serving laboratory, supply/return vents, general lab air movement, air particulate filter types, laboratory hood, and Biological Safety cabinet ventilation.
- Layout of lab furniture, sinks, floor drains, and emergency equipment.
- Storage locations and security of biohazard materials.
- Primary and secondary routes for evacuation and an assembly area.
- Maintain a Biological Safety kit/station outside the laboratory area.
- Current information on the posted Emergency Notification Signage for the laboratory.
- Familiar and coordination with building specific Emergency Action Plan (see building coordinator).

Once there is a good understanding of these facts, appropriate action protocols can be developed.

### **6.3.3.3 Laboratory Specific Emergency Plan**

Immediate action protocols are the step-by-step written procedures to be followed by laboratory workers immediately after the occurrence of a biohazard spill, release or exposure. The primary objectives are to protect personnel and prevent spread of the microorganism to the environment or property. The protocols should be brief, forceful and informative, leaving little room for ignoring or misinterpreting the required actions under the stress of the unanticipated event.

The laboratory PI or supervisor is responsible for training laboratory personnel in laboratory specific emergency plans and specific responsibilities. A copy of the Laboratory Specific Emergency Plan and additional directives must be included in the written Laboratory Specific Exposure Control Plan (Section 4.3.5).

### **Biohazard Releases Outside Biological Safety Cabinets**

Releases or spills outside biological safety cabinets are complex events. The amount released, the physical characteristics of the material, and how the release occurred are important factors in determining the area of involvement. Each release is composed of three somewhat overlapping fractions of the released material.

1. First is the bulk of the material that remains in a more or less confluent puddle.
2. Second is that portion separating from the main body of material in large drops or small streams.
3. Third is that portion which can separate from the main body in airborne particulates of various sizes.

The first two portions comprise the greatest bulk of material that must be disinfected. The third represents only a small portion of the overall bulk with small particles that remain airborne for relatively long periods and transport easily to other areas.

The airborne particles emanating from a biological release are responsible for the initial passive phase of the disinfecting or decontamination procedure. The only required action, in the **30 minutes passive phase**, is to isolate the area and allow the occurrence of physical particulate settling with air dilution. Verify that the Biological Safety cabinet nearby is operating. This passive phase reduces airborne particles, per unit volume, permitting the actual disinfecting effort to proceed. During the passive phase, the required Biological Safety kit/station can be distributed, disinfection strategy decided, and entry team decontamination area staged.

The major components of the required Biological Safety kit/station are the containment biohazard bags and personal protective equipment. At a minimum laboratory personnel responsible for the disinfecting or decontamination of a spill should be provided a long-sleeve gown, HEPA filtered respirator, and medium or heavy rubber gloves. Chemical resistant gloves may be needed due to the disinfectant used or chemicals associated with the release. The gown should be worn over conventional two-piece or jumpsuit type laboratory clothing. Knee length rubber boots are also useful because they are more easily disinfected than conventional footwear and provide greater protection to the wearer against the chemical action of strong decontaminating solutions. Non-laboratory type outer garments should not be worn under the gown. This is not only to preclude potential removal of infectious materials from the laboratory on personal clothing, but also in recognition of the strong bleaching action of hypochlorites often used in disinfecting or decontaminating releases.

The **initial disinfecting or decontamination phase** can begin after 30 minutes with the proper personal protective equipment, tools and effective disinfectant (review

compatibility with reactive chemicals involved in release) staged and donned. The objective is for the entry team to safely enter the spill area, survey extent of release and primary disinfecting or decontamination. Particular attention should be given to splash materials to avoid tracking around the laboratory. Starting from the outer perimeter of the area, encompassed by the splashed as well as the major bulk of the spilled material, liquid disinfectant should be gently poured around the spill area and allowed to flow into the spilled material. Paper towels soaked with the liquid disinfectant may be used to cover the area. Avoid spraying or pouring disinfecting solutions directly onto the spilled materials or other splashing actions that may create airborne particles containing the released agent. The initial disinfecting or decontamination phase allows 20 minutes contact time of the disinfectant with the spilled agent. Make sure that the amount and concentration of the disinfectant used is sufficient to overcome the inactivating action of proteinaceous media or tissues that may be intimately associated with the agent. A general rule of thumb for a disinfectant is a 10% solution of fresh prepared household bleach, which is adequate for most applications.

During the 20-minute disinfectant contact time, the surrounding area should be observed to locate other potential areas that may harbor the spilled agent. If these areas are extensive or cannot be readily reached with liquid disinfectant, consideration should be given to a follow-up disinfection with paraformaldehyde gas (requires Biological Safety Professional approval). Except in the case of the higher risk infectious agents, materials in difficult to reach with disinfectant solution may not pose a particular hazard for personnel. However, media and other suspending components may provide a haven for spore-forming fungi and bacteria growth that may subsequently prove troublesome in preserving the integrity of experiments.

The **follow-up disinfecting or decontamination phase** should begin after the 20-minute contact time. Immediate donning of HEPA filtered respirator, if not already in use, is advisable. Isolation of the area may be less important, unless the agent is suspected to have a high degree of infectious potential. Additional liquid disinfectant should be added immediately but gently to the absorbent surface covering; rubber gloves should be worn. Potentially contaminated objects should be wiped down with disinfectant and set aside. All nearby surfaces should be similarly wiped down. The absorbent surface covering should be gently rolled into a compact package, along with the rubber gloves, placed in a container of disinfectant solution or in an appropriate covered container for autoclaving. The investigator should then wash their hands and face with germicidal soap, change to fresh laboratory clothing, and bag used clothing for autoclaving. All laboratory personnel involved in the spill/release should place special attention to follow up housekeeping procedures, to assure complete disinfecting treatment of surfaces and proper removal of all disposable objects and material involved in the spill.

Decontamination of laboratory spills should also involve common sense. Obviously, all spills do not present the same degree of risk. The preceding discussion is most applicable to relatively large spills of biological materials or for those where a few viable particles may cause infection. Minor spills do occur, however, and may involve very small quantities of agent materials without involving container breakage or significant splashing. If standard aseptic techniques were being used in the

laboratory, the spill should occur on a surface protected with an absorbent covering that has been dampened with an effective disinfectant.

### **Biohazard Releases In Biological Safety Cabinets**

The function of Biological Safety cabinets is not only to provide a work area free from background contaminants, but also to contain any release of microorganisms or other infectious material. Potential contamination from routine procedures is normally dealt with following completion of an experimental procedure or at the conclusion of a work session. A biological spill occurring in the biological safety cabinet should be disinfected immediately and the cabinet airflow maintained. At all times there should be a supply of effective disinfectant within the cabinet so the operator does not have to withdraw their arms before proceeding with decontamination. If the operator's hands and arms have come into direct contact with the biological material, disinfectant should be liberally applied to them. (NOTE: Plastic over-sleeves prevents absorption of spilled materials by porous garments). The area of the spill should be gently flooded with disinfectant sufficient to cover the top tray, drain pans and catch basin below the work surface. While waiting for the elapse of **20 minutes** contact time, the walls, any work surface, equipment, and recoverable supplies not previously treated should be wiped down with a cloth or sponge saturated with disinfectant. Excess disinfectant from the tray and drain pans should be dumped into the cabinet base. Lift out the removable bench tray and perforated front grille. Wipe down all surfaces with disinfectant and replace in position. Place all used cleaning materials in a suitable container and autoclave or treat with a strong hypochlorite solution or appropriate disinfectant for the agent(s). Drain liquid disinfectant from cabinet base into appropriate container(s) and autoclave according to standard procedures. If sodium hypochlorite or an iodophor disinfectant was used, add sufficient thiosulfate to inactivate the oxidant immediately before autoclaving.

If the instruments or equipment contained in the Biological Safety cabinet is not compatible with a liquid disinfectant, problems in assuring penetration by the liquid disinfectant will require procedure modifications. The bulk of the spilled material should be gently flooded with disinfectant as before. Salvageable biological materials in intact containers should be surface disinfected and placed in a covered container. The secondary container is surface disinfected and removed to another Biological Safety cabinet to continue the experiment or to ready the materials for appropriate storage, pending continuation of the experiment. The contaminated safety cabinet is then disinfected by the paraformaldehyde gas procedure (requires Biological Safety Professional approval). Alternatively, small instruments may be placed in plastic bags, the bags sealed, surface disinfected, and removed to an autoclave equipped for dry instrument sterilization. Wet chemical decontamination can then proceed as before.

Spills occurring in total containment cabinets need not be as disruptive for work schedules. Spills in these can usually be flooded with a liquid disinfectant, wiped up (taking care not to cut or otherwise damage gloves with broken glass or other sharp materials present), and cleaning materials placed in a covered container of liquid disinfectant. Remaining materials can be surface disinfected with adherence to

aseptic techniques, and then the experiment can continue. Total decontamination of the cabinet may thus be delayed until the end of the work session.

### **Additional Laboratory Directives**

Additional laboratory directives may be required: a) Location and type of release/spill alarm or notification system; b) How room dilution and local exhaust ventilation is handled; c) UV lamp precautions; d) Perimeter control for contaminated area; and e) Handling special research equipment. The Principal Investigator or supervisor should coordinate beforehand with medical personnel whose actions might require departure from protocol in the event that personal injury accompanies the mishap. Prominent display of the immediate action protocol, at strategic locations within the laboratory, is required if transient personnel frequently use the laboratory.

## **6.3.4 Re-entry after Biohazard Incidents**

### **6.3.4.1 Introduction**

The University Safety Coordinator with assistance from the PI or supervisor will make the determination that an area is safe for reentry after a biohazard incident. Others are not to enter or reenter the area without the consent of the The Environmental Health & Safety Department for any reason until the area is released. The Environmental Health and Safety Department, if appropriate, will allow authorized individuals to re-enter and monitor, control, investigate, remove, rebuild, reinforce, and perform temporary fixes for the facility as necessary before others have access to the area.

Universal precautions shall be used when there is a potential exposure to body fluids or Biohazardous materials. A hazard evaluation of the site by the Environmental Health and Safety Department for potential exposure to laboratory and cleaning personnel. The hazard evaluation will identify the hazardous areas to be decontaminated, followed by cleaning methods to remove the released material.

### **6.3.4.2 Criteria for Re-occupancy of Area**

The Principal Investigator (PI) or supervisor, upon completion of appropriate decontamination procedures, should have assurance that the decontamination has been effective. The PI or supervisor defines the level of assurance required and the conditions under which a release or spill area can be released for normal occupancy. Personal observation during the application of known effective chemical disinfectants in sufficient concentration and adequate contact times may be the criterion selected to allow research to continue following the release or spill of an agent having little human pathogen potential. Another PI or supervisor may delegate this responsibility to an appointed laboratory safety officer. This approach may be adequate for release or spills of low risk agents in properly isolated areas that allows air dilution and settling of airborne particulate before the decontamination process. A critical criterion affecting decisions to re-occupy facilities following a release or spill is personal knowledge by the PI, supervisor or safety officer that complete implementation of the prescribed disinfecting and decontamination procedure was

accomplished. This criterion is usually adequate for releases or spills confined to properly operating Class II and Class III safety cabinets.

As the degree of potential hazard increases, the PI or supervisor may add a refinement, such as swab sample verification for surface contamination of residual viable agents following disinfecting. Alternatively, strategically located cloth or paper patches seeded with resistant microorganisms, such as spores of *Bacillus stearothermophilus*, are effective indicators of disinfection efficiency. These refinements are not direct reading and will sacrifice some time due to incubation requirements that confirms status of viable indicator microorganisms. Accurate swab sampling for the agent will be achieved only if actual laboratory tests have established the reliability of sampling and assay methodologies, and quantitative relationships between sample recovery vs actual level of contamination. Such methodologies are established and available for spores of indicator microorganisms, but their use during wet chemical disinfection may restrict selection of more effective chemical disinfectants with the more resistant spores. This may not be consistent with other laboratory restrictions on the use of disinfectants having the undesirable properties often associated with sporicidal contaminants. The spore indicators are, however, particularly effective for determining the efficiency of gaseous disinfecting procedures. Using spore indicators, with the "no viable organisms present" criterion, is recommended for determining when laboratory operations may resume following a major release or spill of biohazardous material in the open laboratory.

### **6.3.5 Accident Investigation**

Accidents in laboratories and/or clinics and infections resulting from work with biohazards must be promptly reported to the Environmental Health and Safety Department. Prompt and thorough investigations of these incidents can identify their causes so that appropriate actions can be taken to prevent similar occurrences. The IBSC will conduct an investigation of these accidents. The PI, supervisor and laboratory personnel shall provide the IBSC with all necessary information and support needed to successfully complete the accident investigation.

It is important the following incidents are investigated: any serious, unusual, or extended illness of a biohazard worker; any accident that involves ingestion, inhalation or dermal contact of infectious organisms; or inoculation of infectious agents and/or rDNA molecules through the skin. If a potentially infectious organism or recombinant DNA molecule were to acquire the capacity to infect and cause disease in humans, the first evidence of this potential may be demonstrated as a laboratory-acquired infection. Verification that an infection is associated with such work or research will provide sufficient warning for re-evaluation of hazards and initiation of additional precautions to protect ASU-Jonesboro laboratory workers and the public.

The investigation for reporting of all accidents associated with infectious agents or rDNA research should establish the circumstances leading to the accident, including a review of techniques, procedures, types, and uses of equipment that may have been involved in the accident. The IBSC shall provide recommendations for preventing similar occurrences.

### **6.3.6 Risk Assessment Resources/Information**

The laboratory supervisor should periodically review information developed from research conducted in the university laboratory, as well as that reported by other investigators, that may affect current concepts of risk factors associated with potential biohazards in the laboratory. Refer to Section 4.3.3 for specific resources and information.

#### **6.3.6.1 Decontamination Team**

A team effort is the most effective way of meeting decontamination requirements arising from a biological spill or to accomplish periodic facility repairs or modifications. The knowledge of the PI, supervisor, and biohazard workers using their skills as a team will provide the most effective/efficient response to any emergency event in their laboratory. All the decontamination team members will need appropriate training, equipment, and supplies to handle emergency releases based on the specific emergency plan for the laboratory.

### **6.3.7 Laboratory Biological Safety Spill Kits**

#### **6.3.7.1 Required Information at the Laboratory Biological Safety Spill Station:**

- Copy of the current "Emergency Notification Signage" & "Laboratory Specific Emergency Plan".
- Environmental Health and Safety Departmental phone number (972-2862) - to report ALL releases and Blood Borne Pathogen exposures.
- Copy of the "Immediate Biohazard Emergency Response" procedures (Section 6.2).

Note: Label and place at a secure location near the main exit on the outside of the laboratory and keep accessible to all personnel. A Biological Safety Spill Kit is required for all laboratories using rDNA and Biological Safety Level 2 agents. Annually check all supplies to determine if they are still usable. Refer to Laboratory Biological Safety Spill Kit Checklist in Appendix I.

#### **6.3.7.2 Shelf life of Disinfectants**

After selection of a chemical disinfectant that is effective against the microbes or agent being investigated. The PI or supervisor will need to schedule regular procurement of bulk concentrate and maintenance of a working disinfectant supply in the laboratory. One way to assure a continuous supply is to maintain two sources of disinfecting solution, i.e., one for immediate use and the other reserved for emergency use (see biological safety spill kit/station). As the immediate-use supply is depleted, the emergency-use lot replaces it and a freshly prepared solution becomes the emergency-use supply. In small laboratories, effective shelf life of a disinfectant may be exceeded before the working supply is exhausted through normal activities. Supervisors must devise schedules for disposal of ineffective residual disinfectants to be replaced with fresh solutions. Economics must not take precedence over assuring adequate quantities of disinfectants are available to cope with concentrated infectious microbes/agents spilled in the laboratory.



## **Chapter 7**

### **BIOHAZARDOUS MATERIAL TRANSPORTATION and SHIPPING**

Many biological materials are recognized by federal, state, and local governments as hazardous materials and their transportation is subject to regulatory control. Shipments involving dry ice may also be subject to regulatory control. This chapter describes ASU-Jonesboro's procedures for maintaining compliance with government regulations.

#### **7.1 General ASU-Jonesboro Biohazardous Shipping Policies**

If you wish to transfer biohazardous materials from your laboratory to another building, regardless of whether on or off campus, contact the Environmental Health and Safety Department (972-2862).

Transfers using University vehicles may also be subject to DOT regulation. The Environmental Health and Safety Department recommends that private vehicles not be used for transferring biohazardous materials between buildings.

#### **7.2 Biohazardous Material Transportation and Transfer Resources**

##### **7.2.1 Biohazardous Material Transportation**

Controls on biohazardous material transportation are aimed at ensuring public and workers are protected from exposure to any infectious material. Control is maintained through rigorous packaging, appropriate labeling to alert transportation workers, documentation on biohazardous contents, emergency contact information, and worker training in the transportation chain. Regulations include, but are not limited to:

- Public Health Service 42 CFR Part 72. Interstate Transportation of Etiologic Agents.
- Department of Transportation 49 CFR Parts 171-178. Hazardous Materials Regulations.
- United States Postal Service 39 CFR Part 111. Mailability of Etiologic Agents.
- Environmental Health & Safety Department and Health Administration 29 CFR Part 1910.1030.
- International Civil Aviation Organization (ICAO).
- Technical Instructions on Safe Transport by Air.
- International Air Transport Association (IATA) Dangerous Goods Regulations.

##### **7.2.2 Transportation of Materials within Laboratory - High Risk**

Frequent transit of infectious materials within the laboratory is a primary risk factor in the occurrence of biohazardous material releases. The dropping and breaking of primary agent containers is of particular concern. Protective secondary containers for transporting materials are effective in containing such spills. The use of secondary protective containers is required for all biohazardous material during transit within corridors serving laboratories, and transporting to another building on campus. Individual laboratory workers must not

ignore the need for secondary containers, particularly if transit distances are short, the agent is thought to be harmless, or use of secondary containers is inconvenient and increases the time to complete the experiment.

### **7.2.3 Biohazardous Material Transfer**

Requirements on the transfer of biohazardous materials are aimed at ensuring the change of possession is within the best interest of the public and nation. Controls require documentation on personnel, facilities, and justification of need for the transfer process with approval by the federal authority. Regulations include, but are not limited to:

- Public Health Service 42 CFR Part 71.54. Foreign Quarantine, Etiologic Agents, Hosts and Vectors.
- USDA and APHIS 9 CFR Parts 92, 94, 95, 96, 122 and 130 Import or Domestic Transfer of Etiologic Agents.
- Federal Plant Pest Regulation 7 CFR Part 330. Importation of Plant Pests.
- Center of Disease Control 42 CFR Part 72.6. Transfer of Select Agents of Human Disease.
- Department of Commerce 15 CFR Part 730 - 799. Export of Etiologic Agents.

Contact the Environmental Health and Safety Department (972-2862) if you wish to transfer biohazardous materials to another facility.

## APPENDIX A

### Arkansas State University- Jonesboro

### BIOHAZARDOUS MATERIAL APPLICATION FORM      User Registration # \_\_\_\_\_

Note:

complete a separate information form for each research protocol

This space is for Environmental Health and Safety Use ONLY

Form Reviewed by: \_\_\_\_\_ DATE: \_\_\_\_\_ Form Routed to: \_\_\_\_\_  
 Biosafety Professional Review:  Approved    Rejected    Returned    Conditional Approval    IBC \_\_\_\_\_

#### GENERAL INFORMATION (To be completed for all biohazardous material use)

1.      **Principal Investigator:** \_\_\_\_\_      **Date:** \_\_\_\_\_  
          **Protocol Title:** \_\_\_\_\_

To ensure that ASU employees, students, the public, and the environment are protected from biohazards associated with ASU operations including all educational and research pursuits. All investigators using biohazardous agents and materials must complete this form. **Please return the completed form to: Environmental Health and Safety**

**Dates of Proposed Research:** \_\_\_\_\_  
**Location(s) of Research (Bldg./Rms.):** \_\_\_\_\_

2.      Check each use to select the proper appendix(s) to complete for your protocol.

Type of Biohazardous Material	Human Use	Animal Use	Plant Use	Lab work only (In Culture or In Vitro)	Appendix(s) to be Completed
Recombinant DNA					A-1
Select Agent(s)					A-2
Other Biohazardous Material					A-2
Blood borne Pathogens and Other Potentially Infectious Material (OPIM)					A-3

3.      **Risk Assessment** (refer to “Biohazardous Materials Risk Assessment Checklist” Section 4.3.3 of the Biosafety Manual):  
 A.    Completed risk assessment for biohazards and other hazards:  Yes     No  
 B.    Non-Biosafety hazards identified: \_\_\_\_\_

4.      **Proposed Biosafety Level Required** (based on laboratory risk assessment)  
 BSL1     BSL2    No BSL3 or BSL4 Activities Permitted  
 Biological Safety Cabinet(s) Serial #(s) \_\_\_\_\_

5.      **Operational Safeguards and Controls:**  
 Autoclave     Access Control and Warning Signs  
 Gloves     Lab Coat     Safety Glasses     Splash Shield     Respirator/ Mask  
 Laboratory Specific Exposure Control Plan     Emergency Procedures and On-site Laboratory Biosafety Spill Kit  
 Other \_\_\_\_\_

6.      **Laboratory Personnel:**

Name	Location	Current Training (Biosafety Only)

**Appendix A-1**  
**Recombinant DNA Registration Document**

1. Source of cloned DNA (species or strain):
2. Nature of inserted DNA sequence (for example- regulatory or coding region, entire genome, synthetic antisense Sequences, etc.):
3. Vectors used:  
Phage (Vectors used) –  
  
Plasmids (conjugative/non-conjugative) –
4. Viral Component(s) sequence(s) present?
5. Host organism(s) for foreign sequences (such as –E. coli K-12, and any other pertinent details):
6. Volume of material used or stored: More than 10 liters?     Yes     No
7. Please circle the appropriate answer and answer all questions in this section.

Will this involve gene transfer to humans?	Yes	No
Will this involve the use of human blood or tissue? (If yes, fill out Appendix A-3)	Yes	No
Are transgenic rodents generated in this research? What genetic alternation will be made?	Yes	No
Will an attempt be made to obtain expression of a foreign protein? What protein will be produced?  Indicate possible toxicity or other hazards, if any:	Yes	No
Will this rDNA be introduced into animals?	Yes	No
Is any rDNA to be used in this research derived from a plant pathogen?	Yes	No
Are transgenic plants generated in this research? What genetic alterations will be made?	Yes	No

8. Proposed containment level according to NIH  
Physical: \_\_\_\_\_ Biological: \_\_\_\_\_
9. Describe the experimental manipulations and uses of the rDNA. Include handling, storage, and culturing practices in place to reduce exposure risk. Include the types of manipulation, route of administration, route of excretion (if applicable), biohazardous waste management, laboratory security, and additional personal protective equipment recommended for potentially exposed personnel.

---

---

---

---

---

---

---

---

---

---

I affirm that I am aware of and will adhere to the most recent NIH guidelines relating to all aspects of the proposed project. The information above is accurate and complete. I will inform the Environmental Health and Safety Department promptly, in writing, of any significant changes in the information above and will request further approval as needed.

Principal Investigator's Name (Printed or Typed): \_\_\_\_\_ Location of Research \_\_\_\_\_  
Date: \_\_\_\_\_ Principal Investigator's Signature: \_\_\_\_\_

**Appendix A-2**  
**Biohazardous Materials and Select Agent Registration Document**

1. Organism/Agent Name: \_\_\_\_\_  
(genus/species): \_\_\_\_\_
2. Select Agent:  Yes  No  
1. Pathogen:  Human  Animal  Plant: Indigenous to Arkansas? \_\_\_\_\_
3. Route(s) of transmission: \_\_\_\_\_
4. Antibiotic/Antiviral resistant:  Yes  No Other markers \_\_\_\_\_  
Vaccine preventable?  Yes  No Specify: \_\_\_\_\_  
Therapy (antibiotic, antifungal, antiviral, etc.) available?  Yes  No  
Specify: \_\_\_\_\_
5. Toxin Produced:  Yes  No Type/ Concentration: \_\_\_\_\_
6. Volume: \_\_\_\_\_ Liters Storage and Use of more than 10 liters?  Yes  No
7. Organism inactivated prior to other lab manipulations?  Yes  No
8. Method of Inactivation:  Heat  Chemical  Radiation  
 Other \_\_\_\_\_
9. Disinfectant to be used: \_\_\_\_\_
10. Concentrate organism:  Yes  No Level of Concentration: \_\_\_\_\_
11. Specify methods of concentration:  Centrifugation  Precipitation  Filtration  
 Other \_\_\_\_\_
12. Briefly describe experimental protocol for biohazardous material or select agent use:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Type of Manipulation:

Route of administration:

Route of excretion:

Biohazardous waste management:

Additional Personal Protective Equipment recommended for potentially exposed personal:

Laboratory Security Controls:

Where will the research protocol be carried out?  Laboratory  Greenhouse  Animal Facility  
 Off-site Farm  Environmental Release

Principal Investigator's Name (Printed or Typed): \_\_\_\_\_  
Location of Research \_\_\_\_\_

Principal Investigator Signature: \_\_\_\_\_ Date: \_\_\_\_\_

User Registration  
No. \_\_\_\_\_

### Appendix A-3 Blood borne Pathogens & Other Potentially Infectious Materials (OPIM) Registration Document

Principal investigators **MUST** complete Appendix A-3 when proposed research involves use or storage of human blood, human cell lines, even when obtained from commercial sources, and Other Potentially Infectious Material (OPIM). OPIM is material with the potential for transmission of HIV, HBV, HCV, and other blood borne disease, including tissue from animals known to be infected with any of these agents, microbial stocks, and cultures, certain body fluids, unfixed human tissue and primary tissue/cell cultures.

- List names of all human source material(s) and/or OPIM (Other Potentially Infectious Material):  
 Blood     Serum     Feces     Urine     Semen     Tissues \_\_\_\_\_  
 Spinal Fluid     Other \_\_\_\_\_
- Briefly describe experimental protocol for human blood, cell lines, or OPIM use:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Frequency of Manipulation:     Daily     Weekly     Other \_\_\_\_\_
- Type of Manipulation:     Centrifugation     Pipetting     Dissection  
                                   Blending/Mixing     Sonication     Other \_\_\_\_\_
- Laboratory Specific Exposure Control Plan:  
 Review work assignments to determine employee potential for exposure to blood borne pathogens.  
 Identification and Responsibilities of employees covered by the Exposure Control Plan  
 Universal precautions and specific measures on how to minimize the risk of exposure  
 Engineering Controls – biosafety cabinet, centrifuge safety cups, sharps containers, etc.  
 Work practices – hand washing, personal hygiene, labeling, sharps handling, etc.  
 Personal Protective Equipment (PPE) – gloves, lab coat, safety glasses, mask, etc.  
 Housekeeping – cleaning, decontamination and waste handling.  
 Procedures to follow if there is an exposure  
 Hepatitis B vaccine  
 Exposure Incident Reporting and Record keeping  
 Training – Initial and Annual

Refer to U.S. Occupational Safety and Health Administration (OSHA) Blood-borne Pathogens Standard (29 CFR 1910.1030)  
- Covers human blood, other potentially infectious human body fluids or tissues and human cell lines.

Principal Investigator's Name (Printed or Typed): \_\_\_\_\_ Location of Research: \_\_\_\_\_

Date: \_\_\_\_\_ Principal Investigator Signature: \_\_\_\_\_

**APPENDIX A-4**  
**SELECT AGENTS AND RADIOACTIVE MATERIALS**

---

In order to meet requirements under the Public Health Security and Bio-terrorism Response Act of 2002 and the Arkansas Department of Health, Rules and Regulations for Controlling Sources of Ionizing Radiation.

Any faculty member who stores, manipulates, ships, or receives select agents, radioactive materials, or equipment with radioactive sources must register those materials and equipment with the Environmental Health and Safety Department of Arkansas State University.

For those possessing “Select Agents” in their laboratory there is additional requirements for specific security requirements and personnel screening. The details of the security requirements for each agent will be forthcoming from HHS and USDA.

The penalties for violating the regulations are stringent. Those caught either possessing or transferring Select Agents without registration or approval, face jail sentences up to five years and civil penalties up to \$500,000.

Please review the attached list of Select Agents and identify any agents that you may have in your possession. In addition, please identify any radioactive materials in your possession or any equipment with a radioactive source.

Complete the attached forms and return to the Environmental Health and Safety Department.

If you have any questions regarding registration of select agents or radioactive materials, please contact: Environmental Health and Safety, 972-2862

**Registration Form**  
**Select Agents, Radioactive Material & Equipment with Radioactive Sources**

Name: \_\_\_\_\_ Position: \_\_\_\_\_ Department: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_ Building and room number: \_\_\_\_\_  
 Email address: \_\_\_\_\_

Check all that apply:

- I have reviewed the list of select agent microorganisms and toxins and I do not possess or use any of these agents.
- I do possess and/or use one or more of the select agents and have identified the agents. I possess on the attached form.
- I do not possess any radioactive materials or equipment with a radioactive source.
- I do possess radioactive materials or equipment that contains radioactive sources and have indicated those on the attached form.

**Possession of Select Agents includes: viable organisms, nucleic acid or genetic elements from the agent, or vaccines approved by the USDA or FDA**

**HHS SELECT AGENTS**

	<b>Concentration</b>	<b>Quantity</b>
<input type="checkbox"/> Crimean-Congo Hemorrhagic Fever Virus	_____	_____
<input type="checkbox"/> Ebola Viruses	_____	_____
<input type="checkbox"/> Lassa Fever Virus	_____	_____
<input type="checkbox"/> Marburg Virus	_____	_____
<input type="checkbox"/> <i>Rickettsia prowazekii</i>	_____	_____
<input type="checkbox"/> <i>Rickettsia rickettsii</i>	_____	_____
<input type="checkbox"/> South American Hemorrhagic Fever Virus (Junin, Machupo, Sabia, Flexal, Guanarito)	_____	_____
<input type="checkbox"/> Tick-Borne Encephalitis Complex Viruses	_____	_____
<input type="checkbox"/> Variola Major Virus (smallpox virus)	_____	_____
<input type="checkbox"/> Viruses causing Hantavirus Pulmonary Syndrome	_____	_____
<input type="checkbox"/> Yellow Fever Virus	_____	_____
<input type="checkbox"/> <i>Yersinia pestis</i>	_____	_____
<input type="checkbox"/> Abrin	_____	_____
<input type="checkbox"/> Conotoxins	_____	_____
<input type="checkbox"/> Diacetoxyscirpenol	_____	_____
<input type="checkbox"/> Ricin	_____	_____
<input type="checkbox"/> Saxitoxin	_____	_____
<input type="checkbox"/> Tetrodotoxin	_____	_____

**USDA – HHS OVERLAP AGENTS**

	<b>Concentration</b>	<b>Quantity</b>
<input type="checkbox"/> <i>Bacillus anthracis</i>	_____	_____
<input type="checkbox"/> <i>Brucella abortus</i>	_____	_____
<input type="checkbox"/> <i>Brucella melitensis</i>	_____	_____
<input type="checkbox"/> <i>Brucella suis</i>	_____	_____
<input type="checkbox"/> <i>Burkholderia</i> (Pseudomonas) <i>mallei</i>	_____	_____
<input type="checkbox"/> <i>Burkholderia</i> (Pseudomonas) <i>pseudomallei</i>	_____	_____
<input type="checkbox"/> <i>Clostridium botulinum</i>	_____	_____
<input type="checkbox"/> <i>Coccidioides immitis</i>	_____	_____
<input type="checkbox"/> <i>Coxiella burnettii</i>	_____	_____
<input type="checkbox"/> Eastern Equine Encephalitis Virus	_____	_____
<input type="checkbox"/> <i>Equine Morbillivirus</i> (Hendra, Virus, Nipah Virus)	_____	_____
<input type="checkbox"/> <i>Francisella tularensis</i>	_____	_____
<input type="checkbox"/> Rift Valley Fever Virus	_____	_____
<input type="checkbox"/> Venezuelan Equine Encephalitis Virus	_____	_____
<input type="checkbox"/> Aflatoxins	_____	_____
<input type="checkbox"/> Botulinum Toxins	_____	_____
<input type="checkbox"/> <i>Clostridium perfringens epsilon Toxin</i>	_____	_____
<input type="checkbox"/> Shigatoxin	_____	_____
<input type="checkbox"/> Staphylococcal Enterotoxin	_____	_____
<input type="checkbox"/> T-2 Toxin	_____	_____



## USDA LIST OF LIVESTOCK PATHOGENS AND TOXINS WITH HIGH CONSEQUENCE

	Concentration	Quantity
<input type="checkbox"/> African Horse Sickness Virus	_____	_____
<input type="checkbox"/> African Swine Fever	_____	_____
<input type="checkbox"/> Akabane Virus	_____	_____
<input type="checkbox"/> Avian Influenza Virus (highly pathogenic)	_____	_____
<input type="checkbox"/> Blue Tongue Virus	_____	_____
<input type="checkbox"/> Bovine Spongiform Encephalopathy Agents	_____	_____
<input type="checkbox"/> Camel Pox Virus	_____	_____
<input type="checkbox"/> Classical Swine Fever	_____	_____
<input type="checkbox"/> <i>Cowdria ruminantium</i> (Heartwater)	_____	_____
<input type="checkbox"/> Foot and Mouth Disease Virus	_____	_____
<input type="checkbox"/> Goat Pox Virus	_____	_____
<input type="checkbox"/> Japanese Encephalitis Virus	_____	_____
<input type="checkbox"/> Lumpy Skin Disease Virus	_____	_____
<input type="checkbox"/> Malignant Catarrhal Fever	_____	_____
<input type="checkbox"/> Manangle Virus	_____	_____
<input type="checkbox"/> <i>Mycoplasma capricolum</i>	_____	_____
<input type="checkbox"/> <i>Mycoplasma mycoides</i> (Contagious Bovine Pleuropneumonia agent)	_____	_____
<input type="checkbox"/> Newcastle Disease Virus (Exotic)	_____	_____
<input type="checkbox"/> Peste des Petits Ruminants	_____	_____
<input type="checkbox"/> Rinderpest Virus	_____	_____
<input type="checkbox"/> Sheep Pox	_____	_____
<input type="checkbox"/> Swine Vesicular Disease Virus	_____	_____
<input type="checkbox"/> <i>Vesicular Stomatitis Virus</i>	_____	_____

### Recombinant organisms/molecules

Note: 1.) List genetically modified microorganisms or genetic elements from organisms on the select agent list, shown to produce or encode for a factor associated with a disease. 2.) Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences coding for any of the toxins listed in the select agent list, or their toxic sub-units.

Recombinant organisms/molecules:	Concentration	Quantity
_____	_____	_____
_____	_____	_____
_____	_____	_____

### Other restrictions

The deliberate transfer of a drug resistance trait to microorganisms listed in the select agents list that are not known to acquire the trait naturally is prohibited by NIH "Guidelines for Research Involving Recombinant DNA Molecules," if such acquisition could compromise the use of the drug to control these disease agents in human or veterinary medicine.

If you listed any of the above agents, organisms, or molecules in your possession, please check all that apply:

- Absolute minimum amount of the material kept on site.
- A 'real time' log is kept on the amounts of the material on hand.
- Materials are locked up within the laboratory.
- All authorized users are under my direct supervisory control.
- The laboratory is locked after hours, on weekends and when no one is in the laboratory.

### Radioactive Materials & Equipment with Radioactive Sources

List all radioactive sources in your possession.

Materials or Equipment Name	Quantity
_____	_____
_____	_____
_____	_____
_____	_____

### Acknowledgement

I understand that I will be required to comply with federal, state, and local regulations that pertain to all of my research and laboratory activities. I accept responsibility for providing, thorough scheduling, teaching, or training to all personnel involved in my laboratory. The information here is accurate and complete.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

**APPENDIX B**  
**Biohazard Laboratory Job Safety Analysis/Protocol**

	<b>BIOHAZARD JOB SAFETY ANALYSIS</b>	DATE: .... / .... / ....
--	--------------------------------------	--------------------------

**BIOHAZARD JOB DESCRIPTION:**  
**START DATE:** .... / .... / ....    **TIME:** .....am/pm    **TASK DURATION:** .....

**TASK DESCRIPTION:**

#	JOB STEP	BIOHAZARD OR OTHER HAZARD IDENTIFIED	CONTROL METHOD TO ELIMINATE OR REDUCE BIOHAZARD/OTHER HAZARD
1			
2			
3			
4			
5			
6			

7			
8			
9			
10			
11			
12			
13			

**Institutional Biological Safety Committee Members – Sign for Acceptance**

<b>NAME</b>	<b>SIGNATURE</b>				

## APPENDIX C

### Practical Biosafety Guidelines

<b>ASU Laboratory Containment Levels for Biological Research Involving Potential Biohazards</b>		
BIOSAFETY LEVELS (BSI)	BSL-1	BSL-2
<b>A. HAZARD LEVELS</b>		
Degree of hazard	Low risk: E coli K-12	Low to Moderate; Influenza viruses, Mycobacterium sp., Herpes viruses
<b>B. STANDARD MICROBIOLOGICAL PRACTICES</b>		
1. Public access while experiments are in process	Not recommended	Access to the lab is limited when BSL-2 work is being conducted
2. Daily decontamination	Daily and upon spills	Daily and upon spills
3. Biohazardous waste decontamination	Before disposal or pickup	Before disposal or pickup
4. Pipetting	Mechanical device	Mechanical device
5. Eating, drinking, application of cosmetics or contact lenses	Not permitted	Not permitted
6. Hand washing facilities	Required	Required
7. Aerosol minimization procedures	Required	Required
8. Laboratory coats	Recommended (front button coats)	Required (front button coats)
<b>C. SPECIAL PRACTICES</b>		
1. Autoclave	Not required	Must be available
2. Insect/rodent control program	Required	Required
3. Transport of biohazardous waste material for processing (decontamination) away from lab	Red bags in durable, closed, specially marked, leak-proof containers	Red bags in durable, closed, specially marked, leak-proof containers
<p><b>Note 1:</b> All biohazardous unwanted material storage must be placed in labeled, marked, closed, and leak-proof containers, which are under the direct control of responsible laboratory worker(s) until placed in a locked disposal area or autoclaved. All petrescible materials must be refrigerated or picked up within twenty-four (24) hours.</p>		

ASU Laboratory Containment Levels for Biological Research Involving Potential Biohazards		
BIOSAFETY LEVELS (BSL)	BSL-1	BSL-2
<b>D. CONTAINMENT EQUIPMENT</b>		
1. Biological Safety Cabinet (BSC)	Not required	Required for all aerosol generating purposes
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. (Note 2) If high concentrations or 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.
3. Freezers / refrigerators	No biohazard sign required	Biohazard sign must be posted
4. BSC Certification	Certified annually	Certified annually
5. HEPA-filtered vacuum lines	Recommended	Required
6. BSC work surface decontamination	Daily and following spills	Required after each use
7. Personal Protective Equipment (PPE) when working with primary containment (e.g., BSC)	Required – gloves should be worn when handling infected animals and when skin contact with biohazardous materials is unavoidable	Required – appropriate combinations of special protective clothing, gloves, etc., are used for all activities with biohazardous materials. (Note 4)
8. Personal Protective Equipment (PPE) when working outside of primary containment	Required – Gloves should be worn when handling infected animals and when skin contact with biohazardous materials is unavoidable	Required – appropriate combinations of special protective clothing plus NIOSH N95 respirators or better must be worn in rooms containing infected animals
<p><b>Note 2:</b> 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 intra-nasally, and harvesting infected tissues from animals or eggs.</p>		
<p><b>Note 3:</b> These procedures include manipulation of cultures and clinical or occupational 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.</p>		
<p><b>Note 4:</b> 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; and necropsies of infected animals.</p>		

<b>ASU Laboratory Containment Levels for Biological Research Involving Potential Biohazards</b>		
<b>BIOSAFETY LEVELS (BSL)</b>	<b>BSL-1</b>	<b>BSL-2</b>
<b>E. LABORATORY FACILITIES</b>		
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
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
3. Bench top work	Permitted	Permitted only for low-risk procedures
4. Openable windows	Permitted with fly screens	Permitted with fly screens
5. Laboratory separated from the general public	No	No
<b>F. OTHER REQUIREMENTS</b>		
1. Laboratory Specific Technical Training	Required with documentation	Biannual lab training with documentation required
2. Medical Surveillance (baseline serology)	Required only when appropriate	Required only when appropriate
3. Release/spill/accident	Report to lab director right away; medical evaluation, surveillance and treatment as appropriate; maintain written records	Report to lab director right away; medical evaluation, surveillance, and treatment as appropriate; maintain written records
4. Laboratory Specific Exposure Control Plan	Plan prepared with manual adopted; personnel required to be familiar with policies and procedures	Plan prepared with manual adopted; personnel required to be familiar with policies and procedures

## Appendix D

### Biosafety Laboratory Self-Inspection Checklist

#### A. Laboratory Identification

Date: \_\_\_\_\_

1. Laboratory Inspector's Name \_\_\_\_\_

Building \_\_\_\_\_ Room(s)# \_\_\_\_\_

2. Any changes in list of biohazard risk(s)?  Yes (specify below)  No

Biohazardous material:  bacterial  fungal  parasitic  viral  viroids

rickettsial  prions  rDNA  toxins(bio)  chlamydiae

Pathogen:  animals  human  human/primate blood  human body fluids, cells & tissues

(OPIM) Other Potential Infectious Material: (specify) \_\_\_\_\_

3. Emergency Notification Sign current with call-list available?  Yes  No

#### B. Facility/Equipment

1. Biosafety cabinet operational and in good repair?  Yes  No  N/A

2. Biosafety cabinet certification current?  Yes  No  N/A

3. Designated clean area present?  Yes  No  N/A

4. Any biohazardous material in designated clean area?  Yes  No  N/A

5. General lab cluttered (dirty labware, paper, storage, etc)?  Yes  No  N/A

6. Lab airflow from lower-hazard to higher-hazard areas?  Yes  No  N/A

7. Routinely decon biosafety cabinet before & after use?  Yes  No  N/A

8. Cluttered grate in biosafety cabinet?  Yes  No  N/A

9. Cluttered work area in biosafety cabinet?  Yes  No  N/A

10. HEPA filter on vacuum line in good repair?  Yes  No  N/A

11. Is the suction flask too full?  Yes  No  N/A

12. Autoclave working with calibration and log maintained?  Yes  No  N/A

13. Centrifuge in good condition (buckets, rotors, residue)?  Yes  No  N/A

14. Laboratory Biosafety Spill-kit available and stocked?  Yes  No  N/A

**C. Work Practices**

- 1. Adequate control on aerosol-generating procedures?  Yes  No  N/A
- 2. Use of good work practices within biosafety cabinets?  Yes  No  N/A
- 3. Correct disinfectant used, contact time, frequency?  Yes  No  N/A
- 4. Are Laboratory coats worn or not?  Yes  No  N/A
- 5. Are safety glasses worn when required?  Yes  No  N/A
- 6. Any evidence of eating in the lab areas?  Yes  No  N/A

**D. Hazard Communication**

- 1. Biosafety placard posted at entrance to the lab?  Yes  No  N/A
- 2. Is the Exposure Control Plan completed and current?  Yes  No  N/A
- 3. Medical surveillance and Hepatitis B vaccinations current?  Yes  No  N/A
- 4. Any changes or new needs for immunodeficient individuals?  Yes  No  N/A
- 5. Appropriate biosafety cabinet and UV signage present?  Yes  No  N/A
- 6. Training records maintained and lab staff current?  Yes  No  N/A
- 7. Autoclave records and testing current?  Yes  No  N/A

**E. Biohazardous Unwanted Material Handling**

- 1. Labeled rigid containers with lids available?  Yes  No  N/A
- 2. Red bags and approved waste containers used?  Yes  No  N/A
- 3. Putrescible waste refrigerated or picked up in 24 hours?  Yes  No  N/A
- 4. Only biohazard waste in red bags?  Yes  No  N/A
- 5. Appropriate labels and information on containers?  Yes  No  N/A
- 6. Sharps containers used and properly labeled?  Yes  No  N/A
- 7. Use black bags to cover sterilized/treated red bags?  Yes  No  N/A
- 8. Any leakage or articles that will puncture red bags?  Yes  No  N/A

**F. Additional Comments and Remedial Action**

- 1. Comments:  
\_\_\_\_\_  
\_\_\_\_\_
- 2. Remedial Actions:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Remedial Actions completed by: \_\_\_\_\_ Date: \_\_\_\_\_



## APPENDIX E

### Laboratory Specific Exposure Control Plan Template

- **Review work assignments to determine employee potential for exposure to laboratory-acquired infections.**

Principal investigators and laboratory supervisors need to perform an exposure determination concerning which employees may incur occupational exposure to blood or other potentially infectious materials (OPIM), biohazardous materials or lab-acquired infections. The exposure determination is made without regard to the use of personal protective equipment (i.e. employees are considered to be exposed even if they wear personal protective equipment). This exposure determination lists all job classifications in the laboratory and which employees may be expected to incur such occupational exposure, regardless of frequency. At this Laboratory the following job classifications are:

---

---

- **Identification and Responsibilities of employees covered by the Exposure Control Plan.**

Not all employees in the laboratory are expected to be exposed to blood or OPIM, biohazardous materials or lab-acquired infections. However, tasks or procedures that would cause these employees to have occupational exposure are also required to be listed in order to clearly understand which employees in these categories are considered to have potential occupational exposure. At this Laboratory the job classifications and associated tasks for these types of employee categories are as follows:

---

---

Employees have the most important role in the compliance program. The ultimate execution of the Plan rests in their hands. The employee is responsible for the following activities:

- Know what tasks performed have occupational exposure
- Attend blood borne pathogen training sessions
- Plan and conduct all operations in accordance with work practice controls
- Develop and practice good personal hygiene habits

- **Universal precautions and specific measures on how to minimize the risk of exposure**

Universal precautions need to be observed at this laboratory in order to prevent contact with blood or other potentially infectious materials. All Blood, OPIM, biohazardous material, infectious agents, toxins or wild/unknown sources that may be transmitted to humans need to always be considered infectious regardless of the perceived status of the source.

□ **Engineering Controls –biosafety cabinet, centrifuge safety cups, sharps containers, etc.**

Engineering controls along with work practice controls are utilized to eliminate or minimize exposure to employees at this laboratory. Personal protective equipment needs to be used where occupational exposure remains after institution of engineering and work practice controls. At this facility the following engineering controls will be utilized: (list controls, such as biosafety cabinet, centrifuge safety cups, sharps container, etc.)

---

---

Examples:

1. Hand washing facilities or antiseptic hand cleansers, towel or antiseptic towelettes, or are readily accessible to all employees who have the potential for exposure.
2. Contaminated sharps, specimen and secondary containers should have the following characteristics:
  - Puncture-resistant
  - Color-coded or labeled with a biohazard warning label
  - Leak-proof on the sides and bottom
  - Closeable

The above controls should be reviewed annually and maintained on a regular schedule. The schedule for reviewing the effectiveness of the controls is as follows: list schedule such as daily, once/week, etc. Also, list the person who has the responsibility to review the effectiveness of the individual controls, such as the supervisor for each Laboratory, etc.

---

---

Hand washing facilities are available to the employees who incur exposure to blood or other potentially infectious materials. Hand washing sinks are required in the laboratory so they will be readily accessible after incurring exposure. At this facility hand washing, facilities are located: (list locations, such as room number and area in the laboratory)

---

---

If hand-washing facilities are not feasible, an alternative is to use antiseptic cleanser in conjunction with clean cloth/paper towels or antiseptic towelettes. If these alternatives are used hands are to then be washed with soap and running water as soon as feasibly possible. Principal investigators or supervisors who have this type of alternative because of the lack of accessible hand washing facilities should list the location, tasks and responsibilities to ensure maintenance and accessibility of these alternatives.

---

---

After removal of personal protective gloves, employees **must** wash hands and any other potentially contaminated skin area IMMEDIATELY OR AS SOON AS FEASIBLY possible with soap and water. If employees incur exposure to their skin or mucous membranes then those areas shall be washed or flushed with water as appropriate as soon as feasibly possible following contact.

**Work practices – hand washing, personal hygiene, labeling, sharps handling, etc.**

Contaminated needles and other contaminated sharps should never be bent, recapped, removed, sheared or purposely broken. The exception to this is the procedure would require contaminated needles be recapped or removed and no alternative is feasible. If such action is required, then recapping or removal of the needle must be done by the use of a mechanical device or a one-handed technique. In this Laboratory, recapping or removal is only permitted for the following procedures:

---

---

---

(List the procedures and also list the mechanical device to be used or alternately if a one-handed technique will be used.)

In work areas where there is a reasonable likelihood of exposure to blood or other potentially infectious materials, employees are not to eat, drink, apply cosmetics or lip balm, smoke or handle contact lenses. Food and beverages are not to be kept in refrigerators, freezers, shelves, and cabinets or on counter tops or bench tops where blood or other potentially infectious materials are present.

Mouth pipetting/suctioning of blood or other potentially infectious materials is prohibited.

All procedures need to be conducted in a manner which will minimize splashing, spraying, splattering, and generation of droplets of blood or OPIM. Methods that will be employed at this laboratory to accomplish these goals are: (list methods, such as centrifuge cups, biosafety cabinets, etc.)

---

---

---

- Personal Protective Equipment (PPE) – gloves, lab coat, safety glasses, HEPA Respirator, mask, etc.
- Housekeeping – cleaning, decontamination and waste handling.

Contaminated sharps are to be placed immediately, or as soon as possible, after use into an appropriate sharps container. AT this facility sharps containers are puncture resistant, labeled with a biohazard label and leak proof. (Employers should list where sharps containers are located as well as who has responsibility for removing sharps from containers and how often they will be checked to remove the sharps.)

□ **Laboratory Specific Emergency Plan to follow if there is an exposure or release**

Laboratory Specific Emergency Plan (Template)  
Date Completed

1. Primary Laboratory Emergency Contacts. Also include other contacts such as University Police Department
2. General Laboratory Response Procedures for Anticipated Biohazard Emergencies (Fire, Chemical or Biological Releases, Medical Emergency, Tornado, Mechanical Equipment or Facility Emergency, Oral or Written Threat, etc.)
3. Emergency Evacuation Procedures (Escape routes w/diagram, critical laboratory operation shutdown, Headcount and assembly point coordination, laboratory personnel responsibilities and duties, etc.)
4. Description of emergency alarm systems (such as fire alarms, etc.)
5. Detailed laboratory precautionary procedures (list of major potential laboratory biohazards and procedures to reduce biohazard risk)
6. Additional biohazard emergency information (other notifications, news and medical relations, post emergency meeting, incident report system, frequency of plan updates, etc.)

□ **Exposure Incident Reporting and Record keeping**

When the employee incurs an exposure incident, it should be reported to the Environmental Health and Safety Department (2862).

All employees who incur an exposure incident will be offered post-exposure evaluation and follow-up in accordance with the University Policy.

□ **Training – Initial and Annual Biohazardous Materials Training**

ASU requires anyone working with biohazardous materials to have appropriate training. New employees are required to take an introductory course. A separate training course is available for Ancillary Workers. Once initial training is received, a refresher is required. Blood borne Pathogen training – Universal Precautions need to be taken initially with an annual refresher.

- Introduction to Biohazardous Material Management – Basic Microbiological Safety Practices and Techniques
- Biohazardous Materials Manager Refresher (every 2 years)
- Biohazardous materials Handling and Safety for Ancillary Workers
- Biohazardous Materials Ancillary Refresher (every year)
- Initial Blood Borne Pathogen Training – Universal Precautions
- Annual Blood Borne Pathogen Training – Universal Precautions Annual Refresher
- Autoclave Safety Training
- Biosafety Cabinet Training

All persons working with or around biohazardous material(s) must:

- Be instructed in the laboratory specific exposure control plan; entry control procedures; the meanings of the various signs, signals, or other controls used; applicable emergency procedures applying to their work activities and area, recognition and prevention of dangerous situations and/or exposures and the symptoms (acute and chronic) of possible exposures.
- Receive documented training in basic biosafety controls; applicable directives (including use of this handbook); and specific methods and requirements of their work and work area.

Training classes will be offered the Environmental Health and Safety Department.

□ **Record Keeping**

All biosafety records including Blood Borne Pathogen Standard requirements will be maintained by:  
(Insert name of Registered User) \_\_\_\_\_

**Reference: US Occupational Safety and Health Administration (OSHA) Blood-borne Pathogens  
Standard (29 CFR 1910.1030).**

<http://www.osha-slc.gov/SLTC/bloodbornepathogens/index.html>

(update: [https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_id=10051&p\\_table=STANDARDS](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10051&p_table=STANDARDS))

## **Appendix F**

### **Sterilization and Disinfection**

**Sterilization** is the process of treating an object or material to remove or kill all living organisms.

**Disinfection** is the process of killing pathogens agents by chemical or physical means directly applied. Disinfection does not mean the destruction or removal of all organisms. Therefore, this may not necessarily create sterile conditions.

**Decontamination** is defined as the reduction of microorganisms to an acceptable level. The process of decontamination can be achieved by either disinfection or sterilization.

Whether or not sterility is achieved depends on several factors: 1) Types and number of microorganisms; 2) Concentration of the agent; 3) Length of contact time with the agent; 4) Presence of organic matter and dirt; 5) Temperature; 6) Condition and nature of the surface(s). Sterilizing and disinfecting agents attach microorganisms in various ways. Some disinfectants will coagulate or denature the protein rendering the cell nonfunctional. They may injure the cell membrane, altering the normal selective permeability, allowing metabolically important components to escape, or prevent the entrance of food. In addition, they may react with a specific enzyme to prevent it from reacting with its natural substrate.

**There is a wide range of reaction from microorganism to inactivating agents. Most vegetative bacteria, fungi, and lipid containing viruses are relatively susceptible to chemical decontamination. The non-lipid containing viruses and bacteria with a waxy coat occupy a midrange of resistance. Spore forms are the most resistant.**

#### **Methods of Sterilization**

##### **Steam Sterilization**

Autoclaving provides heat and moisture as the damage factors to destroy organisms. Most organisms can be destroyed in the presence of steam under pressure at 121°C for a minimum of 15 minutes. The time is measured after the temperature of the material being sterilized reaches 121°C. The major problem to insuring the reliability of this method, other than time and temperature, is the prevention of air entrapment. Air must be replaced by the steam and adequate exposure time as related to the soil load on contaminated items.

Some type of autoclaves have downward or gravity displacement which takes advantage of the difference in air density relative to steam. The displaced air is driven out through the drain line located in the lower front of the chamber. A valve in the drain line remains open until a specific pre-set temperature is reached. When this temperature is reached, the valve closes and steam continues to enter until the pre-set pressure or temperature is achieved. A concern with this type of autoclave is that air trapped in closed or upright containers placed in the chamber, or reduced loads in the chamber are not completely displaced. If the air is not displaced, the temperature will remain to low in that area throughout the sterilization process thereby not being effective. Therefore, autoclaves of this type should not be overloaded; tightly packed and open containers should be turned on their sides.

High vacuum autoclaves draw a vacuum in the chamber prior to entrance of steam. If the vacuum is greater than 27 inches Hg, the air removal concern is alleviated. The principal advantages of the

high vacuum sterilizers are their fast cycle time and the fact that a much larger volume of material can be processed per day than with downward displacement. Another advantage is the minimized damage to materials because of the shortened overall exposure to heat. Heavily soiled items, especially if the soil is of a proteinaceous nature, should be autoclaved longer because soil may protect the microorganism from the lethal effects of wet heat.

Other practices that improve the efficacy of autoclaving include removing and cleaning the equipment plug screen or strainer daily to make sure it is free of dirt, dust, or sediment, and cleaning the interior surfaces of residue collected from the steam or materials being sterilized. Spore strips or other satisfactory performance testing materials can be placed at various locations within the autoclave as indicators of sterility.

**NOTE:** Autoclave tape does not assure sterility; the tape indicates only that the proper temperature has been achieved and is not dependent on time.

### **Dry Heat**

Dry heat is used for the sterilization of anhydrous oils, greases, powders, etc., that cannot be easily permeated by steam. Dry heat is less efficient than wet-heat sterilization and requires longer times or higher temperatures; specific time and temperature must be determined for each type of material being sterilized.

Sterilization can usually be accomplished at 160-170°C for periods of 2-4 hours. Higher temperatures and shorter times may be used for heat resistant materials. The heat transfer properties and arrangement of articles in the load are critical to insuring effective sterilization.

### **Gas Sterilization**

A variety of gases and vapors possess germicidal properties. The most useful are formaldehyde and ethylene oxide. Sterilization can be achieved when these are employed in closed systems and under controlled conditions of temperature and humidity.

Ethylene oxide gas is lethal for microorganisms including spores, viruses, fungi, and highly resistant thermophilic bacteria. The effects of time, temperature, concentration, and humidity upon the rate of sterilization of ethylene oxide are directly related. Doubling the concentration will achieve sterilization in about half the time. The effect of temperature is that with each 10°C temperature increase, the sterilization activity is doubled. At a relative humidity (RH) of 30%, sterilization is most rapid, becoming progressively slower as the relative humidity increases to 100%.

All materials sterilized with ethylene oxide must be aerated at least 24 hours before contact with the skin. Mixtures of 3-10% ethylene oxide in air are explosive. Commercially available mixtures of ethylene oxide in Freon or CO<sub>2</sub> are not explosive and can be used safely.

### **Other Factors Associated With Sterilization**

Other factors that are associated with sterilization are: 1) Number of organisms on the material and their resistance to the sterilizing agent; 2) Protection afforded organisms by extraneous matter – direct steam must establish direct contact on all surfaces; 3) Exponential death rate. The numbers of organism dying per unit of time are proportional to numbers present at start to time interval; 4)

Functional efficiency of sterilizer and reliability of mechanical components; 5) Human error in operation of equipment.

### **Standardization of Sterilization (Integrated Factors)**

Integrated factors on standardizing sterilization are: 1) Proper preliminary cleaning, assembling, and packaging of supplies to insure direct steam contact; 2) Proper loading of the sterilizer; 3) Approved sterilizer with demonstrated reliability; 4) Adequate exposure period that will provide for complete penetration of the load with a liberal margin of error.

### ***Steam Sterilization***

#### Advantages

1. Destruction of most resistant bacterial spores with relatively brief exposure.
2. Easy control of lethality for various materials and supplies.
3. No toxic residue and materials following sterilization process.
4. Most economical method.

#### Disadvantages

1. Incomplete air elimination from sterilizer depresses temperature and prevents sterilization. Air is a stubborn opponent to the diffusion and expansion of steam.
2. Possible superheated steam with diminished microbial power if sterilizer is used incorrectly.
3. Unsuitable method for sterilization of anhydrous oils, greases, and powders.



## ***Ethylene Oxide Sterilization***

### Advantages

1. Not deleterious to heat-labile materials.
2. Terminal sterilization of packaged items.
3. Egress of gaseous residues.
4. Penetrability.
5. Not readily inactivated by organic matter.
6. Simple equipment can be used.

### Disadvantages

1. Special handling because of flammability, toxicity.
2. Long sterilization and decontamination time.
3. Potential health hazard; fumes must be monitored.
4. Decreased effectiveness when improperly processed.
5. More costly than heat.

## ***Chemical Disinfectants***

Chemical disinfectants are effective alternatives since steam sterilization is not feasible for use in large spaces, surfaces, and stationary equipment; high temperatures and moisture also may damage delicate instruments. There are many trade names for the wide variety of disinfectants. Basically, the chemical disinfectants fall into the following categories: acids/alkalis, alcohols, chlorides, formaldehyde, gluteral-dehyde, iodine, mercurical, phenolics, and quaternaries.

The relative resistance to chemical disinfectants can be substantially altered by such factors as: 1) Contact time; 2) Human error; 3) Concentration; 4) Presence of organic matter and dirt; 5) Temperature; 6) Humidity; 7) Types and numbers of microorganisms; 8) Condition and nature of the surfaces.

The degree of success achieved with chemical decontaminants may range from minimal inactivation of the target microorganism to sterility, depending upon how these factors are manipulated.

## Selecting Chemical Decontaminants

No single chemical disinfectant or method will be effective or practical for all decontamination situations. Therefore, consider when selecting chemical disinfectants and procedures, the purpose for decontamination and the interacting factors. The following questions will help in choosing which chemical disinfectant is best: 1) What is the target microorganism?; 2) What disinfectants are known to inactivate the target microorganism(s)?; 3) What degree of inactivation is required?; 4) How is the microorganism suspended (i.e. simple or complex, on solid or porous surfaces, airborne)?; 5) What is the highest concentration of cells anticipated to be encountered?; 6) Can the disinfectant be expected to contact the microorganisms and can effective contact duration be maintained?; 7) Is it compatible with the material to be contaminated?; 8) What is the product stability?; 9) Will there be an absence of residues?; 10) Is the disinfectant nontoxic, non-allergenic, non-carcinogenic, non-irritating, and have no noxious odors?

Agar, proteinaceous nutrients, and cellular materials can be very effective in physically retarding or chemically binding active moieties of chemical disinfectants. These interferences will dictate the use of disinfectant concentrations and contact items in excess of those shown to be effective in the tube test.

## Monitoring Sterilization

All sterilizers should have time-temperature recorders to provide evidence of adequate exposure for each load. Evidence that a sterilizing temperature has been held for an adequate time, however, does not insure sterilization. This is because the temperature is measured at the outlet valve. Therefore, it does not indicate whether adequate sterilization occurred within dense volumes of liquid or large, dense, fabric-wrapped packs. Residual air or super heating may also result in incomplete sterilization. The use of chemical monitors, i.e. test-tapes, within the autoclave provides only an indication that a sterilizing temperature may have been reached. However, such monitors do not show whether there was adequate exposure. The best means of insuring sterility is to use a biologic spore monitor.

Microorganisms chosen for spore strips are more resistant to sterilization than are most naturally occurring contaminants. The test organisms are in high concentrations to insure a margin of safety. The spores will be in either impregnated filter-paper strips or in solution in glass ampoules. For steam and hot-air sterilization, the thermophile, *Bacillus stearothermophilus*, is used. *Bacillus globigii* is used for ethylene oxide.

Most spore strip preparations are provided in envelopes that contain one or two strips and a control strip. The test strips are packaged in separate envelopes that are removed and sterilized at the time other material is processed. Subsequently, the test strips and control strips are cultured by placing the strips in a tube of tryptic-digest, casein-soy broth. These are incubated at 37°C for gas sterilization and 56°C for steam sterilization. Other types of spore preparations are commercially available. The manufacturer's directions should be followed closely.

Steam and hot air sterilizers should be tested once a week. Every load of material sterilized with ethylene oxide that is to be placed in contact with deep tissues should be tested.

Place the test strips in the center of the test specimen. Never place the strips on an open shelf in the autoclave. Place an ampoule containing a spore solution in the largest vessel to test fluid sterilization.

Handling the spore strips in the laboratory requires considerable care to prevent secondary contamination. Make the transfer with sterile forceps and scissors. Take care not to cross-contaminate the sterilized spore strips with the control strip.

Perform gram staining and sub culturing to prevent false-positive reports that could result from secondary contamination of these cultures.

Whenever positive results are obtained, retest the sterilizers immediately with careful examination of thermometer and pressure gauge readings as well as review of recent time and temperature records. If any deficiency is observed, or if the repeated sterility test still results in growth, engineering personnel should be consulted promptly.

## **APPENDIX G**

### **Autoclave Program**

#### **Autoclave Safety**

All ASU faculty, staff and students must be trained to operate an autoclave properly and safely before use. The physical hazards involve heat, steam and pressure. The biological hazards involve potential exposure to viable human pathogens. First review the operational and safety instructions found in the manufacturer's operating manual. Additional autoclave training is available and provided by the Environmental Health and Safety Department upon request. This training will focus on proper autoclave operating procedures, safety practices, maintenance and testing for effectiveness.

#### **Important Safety Practices**

- Load the autoclave properly per the manufacturer recommendations
- Be sure to clean the drain strainer before loading the autoclave
- Before loading containers of liquids into the autoclave, the caps must be loosened to avoid having the bottles shatter during pressurization.
- Use a tray with a solid bottom and walls to contain bottles and catch spills.
- Add ¼ to ½ inch water so the bottles will heat evenly.
- Don't load plastic materials that are not compatible with the autoclave.
- Individual glassware pieces should be within a heat resistant plastic tray on a shelf or rack and never placed directly on the autoclave bottom or floor.
- Make sure the door of the autoclave is fully closed and the correct cycle has been selected before starting.
- Wear heat resistant gloves when cracking the autoclave door open after a run
- Before removing autoclaved items, wait 5 minutes for load containing only dry glassware and 10 minutes for autoclaved liquid loads.
- When removing items from the autoclave, wear a rubber apron, rubber sleeve protectors, heat resistant mitts and a face shield. Remove the load and let the glassware cool for 15 minutes before touching it with ungloved hands.
- Be alert for autoclaved liquid bottles, which are still bubbling. Let liquid loads stand in an out-of-the-way place for a full hour before touching with ungloved hands. Hot glassware and scalding liquids will cause burns and serious harm.

#### **Testing Autoclaves for Effectiveness**

Autoclaves used for pathogen kill-loads or clean glassware sterilizing cycles, should be routinely tested once per month for killing effectiveness. Before placing new autoclaves into service, killing effectiveness testing must be completed. The most common method of testing is using commercially available test indicator kits with spore strips (usually *Bacillus stearothermophilus*). The spore strips are placed in the center of a typical load and ran through a sterilization cycle. The spore strips are incubated with the non-autoclaved strips. To remove the spore strips from the biohazard bag without exposure to the contents, place the fresh spore strips inside a glass screw cap tube. Tie a strip around the neck of the tube. Bury the tube in the center of the load as you build it. Thread the string out of the top of the bag before you tie it with autoclave tape. After the kill cycle is completed, open the bag and pull on the string to retrieve the spore strip for incubation. If growth is noted on the autoclaved spore strips, try increasing the run time. If growth still occurs with run times of 45 minute or more, the autoclave may need maintenance and repair.

Autoclave performance information:

Autoclaves shall be tested before being placed into service, and then tested periodically for effectiveness.

### Testing Periodicity or Schedule

- Every 40 hours of use or monthly (whichever is shorter). Required for autoclaves that are used to inactivate human or non-human primate blood, tissues, clinical samples or human pathogens.
- Every 6 months. Required for autoclaves that are used to inactivate other material.

### Method of Testing

- A commercially available test indicator kit that uses bacterial spores (*Bacillus stearothermophilus*) is the approved method of testing autoclave efficiency. Most spore vial test kits require 56 to 60 degree incubation of the autoclaved test vial along with a non-autoclaved control vial. Incubation causes surviving spores to grow.
- New autoclaves  
Before placing an autoclave into service, a test load approximating the weight and density of the type of waste generated shall be autoclaved with test spore vials. The spore vials should be placed at the bottom, top, front, rear and center of the autoclave chamber. This can be achieved by either:
  - Placing vials at those positions within one large test load, OR
  - Making several smaller test packs with one vial at the center of each and placing the packs at those locations within the chamber.

The appropriate parameters for sterilizations including temperature, pressure and treatment time shall be determined in this way.

- Autoclaves already in use

Needs periodic testing, place a spore vial in the very center of a test load prior to autoclaving.

### Storage Information

- Please read the spore vial product information sheet for appropriate storage information, but, in general, spore vials should not be frozen. Each batch of vials has an expiration date. Vials should not be used after their expiration date.

### Record keeping

The following records regarding autoclave use must be maintained:

1. On-site maintenance records
2. Autoclave use log (Each load of material inactivated shall be logged as follows:)
  - Date, time and operators name
  - Type and approximate amount of waste
  - Confirmation of sterilization
    - Record the temperature, pressure, and length of time the load is sterilized. Please note that temperature sensitive autoclave tape is not sufficient

## **Autoclave Operating Procedures**

**A written sterilization procedure shall be in place for each workplace. This shall include the following:**

### Parameters

- Appropriate parameters for sterilization shall be determined from the testing with spore vials.
- The time it takes to sterilize a load will change, depending upon the load density and the sterilization cycle one chooses. Therefore, tests should be performed which imitate these various situations.

### Protocol

- Identification of standard treatment containers and proper load placement shall be made.

### Cleaning

- The autoclave and work areas shall be cleaned after every use and the work area shall be disinfected as needed.

## **Autoclave Operation and Safety Training**

Autoclave training is given by the Environmental Health and Safety Department upon request. The training is geared toward research staff. It goes over proper use of autoclaves and how they may be maintained and used properly. Safety training is also given. If there are any additional questions on autoclave safety, contact the Environmental Health and Safety Department at 972-2862.

## APPENDIX H

### Sharps and Laboratory Glass

#### Is it a Sharp or Laboratory Glass?

There is a difference between “sharps” waste and “laboratory glass” waste, and it is important to understand the difference and handle these wastes accordingly.

#### Sharps

“Sharps” are a restricted waste and must not be disposed of in the regular waste stream. The term “sharps” is a regulatory waste classification associated with those instruments used to puncture, cut or scrape body parts and that as waste, can cause punctures or cuts to solid waste handlers or the public. Sharps must be handled with special precautions and any instrument listed below, that looks like it is meant to be used in this manner, must be disposed of as sharps waste.

The sharps definition includes, but is not limited to, the following “SHARPS” items:

- Hypodermic needles
- Syringes (plastic, glass or metal) still connected to the needle
- Sharp or broken glass contaminated with biohazardous materials
- IV tubing with needles attached & suture needles
- Lancets
- Scalpel blades
- Glass Pasteur pipettes
- Microtome blades
- Dental scalers
- Razor blades
- “Other” sharp metal laboratory waste

#### Laboratory Glass

Uncontaminated, non-sharp and unbroken “Laboratory Glass” is not a restricted waste and can be disposed of in the regular waste stream after placement in appropriate packaging to prevent breakage. Uncontaminated broken laboratory glass must be placed into a container labeled “broken glass” (closable, puncture resistant and leak proof) prior to disposal in the regular waste. This process will minimize the potential of punctures or cuts to solid waste handlers or the public.

The following are not sharps:

- Non-sharp laboratory glass
- Plastic items (except for syringes still connected to the needle)
- Plastic pipettes
- Solvent bottles
- Light bulbs
- Any paper materials
- Pipette tips
- Aerosol cans or cans of any type

- Any Scintillation vial not containing biohazardous material
- Items with liquid (except for blood in vacutainers)

## **Handling, Storage and Disposal of Laboratory Sharps**

### **Handling Laboratory Sharps**

The best way to prevent cuts and sticks is to minimize contact with sharps. That means disposing of them immediately after use. The first step is to obtain an appropriate sharps disposal container. These containers are closable, puncture resistant, leak proof on the sides and bottoms, and available in 1 quart, 2 gallon and 8 gallon sizes. Sharps disposal containers must be easily accessible to laboratory personnel, labeled and located as close as feasible to the area where sharps are used. The puncture-proof sharps containers are available from Environmental Health and safety at 972-2862.

When discarding sharps:

- Never bend, shear, break or recap disposable needles or remove from disposable syringes.
- Immediately following use, place the item into the sharps disposal container.
- Never reach into the sharps disposal container,
- Never empty the contents of the sharps disposal container into another container.
- Never remove the lid from the container
- Never overfill a sharps disposal container; no materials should be sticking out the top
- Never force materials into a sharps disposal container

Working with laboratory sharps is a major hazard that needs to be reviewed and included during the risk assessment process to minimize laboratory personnel exposure. Two of the major risks when using sharps are accidental injection and the creation of aerosols. Needles and syringes should only be used when there is no reasonable alternative. Work that may create biohazardous aerosols must be performed in a biosafety cabinet whenever possible.

### **Storage of Laboratory Sharps**

It is required by law to keep the four kinds of used sharps segregated by their type of contamination present. It is red in color and equipped with a tight fitting lid for use during handling and transport. Biohazardous material contaminated sharps must be labeled with an International Biohazard Symbol. Read the authorized sharps container manufacturer's instructions and recommended user training information prior to use.

The four major criteria for sharps container safety performance are: functionality; accessibility; visibility and accommodation. This criteria includes closure mechanisms, stability, size, shape, mounting brackets, opening/access mechanism, handles, placement location, installation height, fill status, labeling, illumination, security, portability, ease of assembly, operation, storage and flexibility of design.

### **Disposal of Laboratory Sharps**

All sharps must be disposed of in authorized puncture-proof and leak proof containers indicating kind(s) of sharp waste contamination present. Once containers are filled, biohazardous material contaminated sharps must be autoclaved (if feasible) and disposed through the Environmental Health and Safety Biohazard waste disposal program. Laboratory sharps cannot be placed with



regular trash. Care must be taken to follow these procedures to prevent serious injury and violation of regulation.

If at all feasible, autoclave the biohazardous material sharps container. Place a piece of autoclave tape over the biohazard symbol on the container prior to autoclaving. The vent holes on the lid should not be covered during the autoclave cycle. After autoclaving, re-label the container as “non-contaminated sharps waste” with the room number and principal investigators name. Seal the labeled container and place at the designated collection point for your department. If you do not know the designated collection points for your facility, contact Environmental Health and Safety (972-2862). Large plastic buckets used for glass Pasteur pipettes are not autoclavable so they must not be used for items with biohazardous material contamination.

If the sharps were used with hazardous material, radioactive material cannot be safely autoclaved, or you do not have an autoclave in your laboratory, contact Environmental Health and Safety for information on alternatives. All untreated laboratory sharps containers must be labeled with the kind(s) of waste contamination present, sealed appropriately, and placed at the designated collection point for your department.

## APPENDIX I

### Laboratory Biosafety Spill Kit Check List

#### **Personal Protective Equipment:**

Gloves (latex/nitrile/rubber gloves, size large or sized to fit each kit user), face shield, safety goggles or safety glasses with side shields, HEPA masks or respirator, shoe covers.

#### **Cleanup Supplies**

2 red bags, 2 cloth rags, 2 clear bags, brush, roll of clear of tape, flashlight, barricade warning tape, anti-microbial wipes. Household bleaches or spray disinfectant, paper towels, absorbent-sock, decon pad, vermiculite, scoop, floor drain cover. Mechanical means for dealing with broken glass, forceps and small dustpan and broom. Sharps container or bucket labeled "Broken Glass" (Metal or thick plastic) to collect and dispose of broken glass. Specific directions and MSDS for use of complicated equipment and disinfectants in the biosafety spill kit.

Note: Annually, check all supplies for deterioration and replace disinfectants or determine if they are still usable.

#### **User Information:**

Post on the outside of Laboratory Biosafety Spill Kit container:

- Inventory sheet of equipment and materials in the biosafety spill kit.
- Phone contact number for responsible Principal Investigator/Supervisor.
- EHS Phone# 972-2862 to report ALL releases & Blood Borne Pathogen exposures.

Available inside the Laboratory Biosafety Spill Kit:

- Copy of the Emergency Notification Signage for the laboratory
- Copy of the Laboratory Specific Emergency Plans for the laboratory
- Copy of the Immediate Biohazard Emergency Response procedures

#### **Basic Biosafety Spill Kit for Individual Work Area:**

Disinfectant (bleach 1:10 dilution, prepared fresh daily) or biohazard specific disinfectant

Absorbent pads, pillows & material (paper towels)

Waste Container (biohazard bags, sharps containers)

Personal Protective Equipment (lab coat, gloves, eye and face protection)

Mechanical Tools (forceps, small disposable dustpan and broom)

**APPENDIX J**  
**Biosafety Cabinet Summary Chart**

The summary chart below compares the different biological safety cabinet types for performance characteristics and applications of use. Biological safety cabinets are among the most effective and most common primary containment devices used in laboratories with biohazardous material.

Type	Face Velocity	Airflow Pattern	Radionuclides/ Toxic Chemicals	Biosafety Levels	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
Class II Type B1	100	30% recirculated through HEPA; exhaust via HEPA and hard ducted	Yes(Low levels/volatility)	2,3	Yes
Class II Type B2	100	No recirculation; total exhaust via HEPA and hard ducted	Yes	2,3	Yes
Class II 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	Yes	3,4	Yes

## APPENDIX K

### Laboratory Security Issues

In response to National Concerns and recent catastrophic events, the following information has recommendations for improving laboratory security. These actions should be taken for your safety and the security of sensitive areas on campus:

1. All areas of the University having electronic locking devices of any type, should make whatever changes to their systems necessary to fully enable the system which results in access by such device at all times.
2. All areas where research is conducted utilizing hazardous material, radioactive material, biohazardous material, and other sensitive materials should have controlled access for authorized personnel only.

Laboratories using biohazardous materials must be kept secured at all times. Several federal, state and consensus standards required that the laboratory doors and hazardous material areas have at a minimum, limited access and required the areas be kept locked when no laboratory staff are present. Security recommendations also include having a routine intra-laboratory inventory mechanism for identifying missing biological, hazardous or radioactive material inventory. This requires an ongoing inventory be maintained.

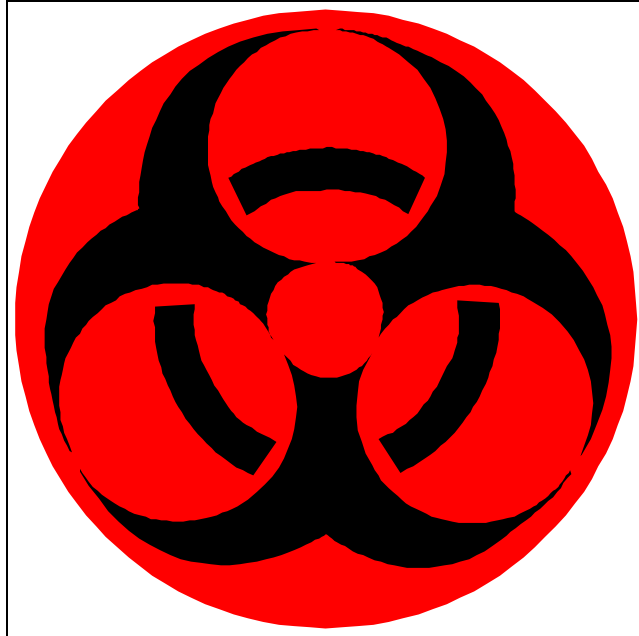
Laboratories have also experience thefts, many of which occurred because doors were left open and laboratories were unattended. Computers, wallets, and other personal items have been stolen. There has been “unauthorized sharing of supplies” from laboratories. There is also the potential for sabotage to ongoing research. Laboratory Principal Investigators or Supervisors need to take these steps in order provide security against terrorism, larceny, and to remain in compliance with various regulations:

1. All staff should wear university identification badges.
2. Approach any visitors that appear to be wandering in laboratory areas and ask if you can help direct them.
3. Lock all equipment (e.g. freezers, cabinets, incubators and scintillation counters) that may contain biohazardous material and are located in hallways or areas outside of laboratories.
4. Keep laboratory doors closed at all times (they also provide correct air flow and fire safety).
5. Lock laboratory doors when no one is present.
6. Post and keep current the “Emergency Notification Signage” on laboratory doors. Include name of responsible person, a second person knowledgeable with the laboratory and a 24-hour contact number (ASU).

Take an inventory of all hazardous and biohazardous material. Track the use of this material and report any missing inventory to ASU and Environmental Health and Safety.

**APPENDIX L  
BIOHAZARD WARNING SIGNS**

**HUMAN BIOHAZARD  
(ESCORT REQUIRED – DO NOT ACCESS THIS AREA)**



**RESTRICTED ACCESS**

**ANIMAL  
BIOHAZARD  
(ESCORT REQUIRED)**

**RESTRICTED ACCESS**

**PLANT  
BIOHAZARD  
(ESCORT REQUIRED)**

---

Page intentionally left blank



ARKANSAS STATE  
UNIVERSITY



ENVIRONMENTAL  
CHEMICAL & LABORATORY  
COMPLIANCE MANUAL



**Arkansas State University**  
**Arkansas Biosciences Institute**

**NOTES**

(October 14<sup>th</sup>, 2014)

---

**Environmental, Chemical & Laboratory Compliance  
Manual**

---

1. Date this manual was officially last updated: January 27<sup>th</sup>, 2003.
  2. Original text is in **black** characters. No original text has been deleted.
  3. Updates are in **red** colored characters, and should be considered as suggestions only.
  4. Some hyperlinks are suggested in the following pages (**red** characters on **yellow** background):
    - Page 17. Governing Principles and Procedures for Laboratory Safety. <http://www.astate.edu/dotAsset/31ef59c4-1279-4cbb-bee3-0d2a39a9ba5d.pdf>, June 5, 2009, Page 13.
    - Pages 25 and 40. EPA listed hazardous wastes. <http://www.epa.gov/osw/hazard/wastetypes/pdfs/listing-ref.pdf>.
-

## TABLE OF CONTENTS

	<u>Page</u>
.....	
Notice to Employees .....	1
Employee Rights .....	1
Hazardous Chemical .....	1
Exemptions to the Act .....	2
Educational Programs .....	2
Material Safety Data Sheets (MSDS) .....	3
Labels .....	4
Hazard Labeling System .....	5
Handling Chemicals .....	6
Chemical Storage .....	7
Chemical Stability .....	7
Incompatible Chemicals .....	8
Shock Sensitive Chemicals .....	9
Solvents .....	9
Compressed Gases .....	10
Restricted Areas .....	10
Waste Disposal .....	11
Chemical Spills .....	14
Personal Protection .....	15
Injury and Illness .....	18
Personal Contamination .....	18
Classification of Toxic Materials .....	21
Appendix A - EPA Listed Hazardous Wastes (1993) .....	25
Appendix B - EPA Listed Acute Hazardous Wastes (1993) .....	40
Appendix C - Chemicals OK to Flush Down the Drain .....	47
Appendix D - High-Energy Oxidizers .....	48
Appendix E - Compatibility of Chemicals According to Hazard Class .....	49
Appendix F - Segregation of Chemicals for Storage .....	50
Glossary .....	51
References .....	57

---

Page intentionally left blank

## NOTICES TO EMPLOYEES

Your employer is required to advise you of your rights regarding the Chemical Right to Know Act. This pamphlet meets the requirement in part.

In addition, standard "Notice to Employee" forms are posted at locations where notices are normally posted.

It is to your advantage to know your rights. Take time to read the "Notice to Employee" form posted.

## EMPLOYEE RIGHTS

Employees who may be exposed to hazardous chemicals are guaranteed access to the following:

- Written Hazard Communication Program
- Work place chemical lists
- Material safety data sheets
- Chemical exposure information

In addition, employees shall receive training on the hazards of chemicals and on the measures they can take to protect themselves from those hazards.

An employer must provide its employees with appropriate personal protective equipment. Employees may be required to purchase common items such as safety glasses. However, special items such as respirators, lab aprons, face shields, gloves, etc., will be provided by the employer.

An employee has a right to file a complaint against his employer regarding alleged violations of the Chemical Right to Know Act. If one files a complaint, the Act protects him from:

- Discharge
- Cause for discharge
- Discipline
- Discrimination
- Loss of pay, position, seniority or benefits

Alleged violations of the Act should be referred to ones supervisor, the Personnel Department, or the Environmental Safety Department. However, one always has the right to file a complaint with the Arkansas Department of Labor, (501) 682-4541.

Providing hazardous chemical information does not affect the liability of ones employer with regard to the health and safety of employees. The employer still has the responsibility to take action to prevent the occurrence of occupational disease and unnecessary exposure.

## HAZARDOUS CHEMICAL

The Public Employees Chemical Right to Know Act defines a Hazardous Chemical (substance) as: any element, chemical compound, or mixture of elements or compounds, which is a physical hazard or a health hazard. A Hazardous Chemical is also defined as a chemical listed in any of the following:

- OSHA, 29CFR1910, Subpart Z, "Toxic and Hazardous Substances"
- ACGIH, "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Place" (latest edition)
- NIOSH, "The Registry of Toxic Effects of Chemical Substances" (latest edition)

A physical hazard is defined as: a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, an explosive, a flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

A health hazard is defined as: a chemical for which there is statistically significant evidence based on at least one study

conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. Included are:

- toxic
- carcinogens
- reproductive toxins
- sensitizers
- neurotoxins (nerve)
- hepatotoxins (liver)
- agents that act on the hematopoietic system (blood)
- agents that damage the lungs, skin, eyes, or mucus membranes
- highly toxic
- irritants
- corrosives
- radioactive materials
- biohazards
- nephrotoxins (kidney)

A Carcinogen or Potential Carcinogen is defined as a chemical listed in any of the following:

- National Toxicology Program, "Annual Report of Carcinogens" (latest edition)
- International Agency for Research on Cancer, "Monographs" (latest edition)
- OSHA, 29CFR1910, Subpart Z, "Toxic and Hazardous Substances"

## EXEMPTIONS TO THE ACT

The Public Employee Right to Know Act does not apply to chemicals in the following categories:

- Any article formed to a specific shape that does not release hazardous chemicals under normal use
- Products intended for personal consumption
- Any food, food additive, drug, cosmetic or distilled spirits, wines or malt beverages packaged for sale to consumers
- Foods, drugs, or cosmetics intended for personal consumption by employees while in the work place
- Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substance Act (15 U.S.C. 1261 et seq.) respectively, where the employer can demonstrate it is used in the work place in the same manner as normal consumer use, and which use results in a duration and frequency of exposure which is not greater than exposure experienced by consumers.

If you are not sure a chemical in your work area is exempted, contact your supervisor or the Environmental Safety Department (3803).

## EDUCATIONAL PROGRAMS

The University must provide, at least annually, an education and training program for employees using or handling chemicals.

Additional instruction is required whenever the potential for exposure to hazardous chemicals is altered or whenever new information concerning a chemical is received.

New or newly assigned employees must be provided training before working with or in a work area containing hazardous chemicals.

Training programs shall include, as appropriate, the following:

- Interpreting labels and MSDS
- Location of hazardous chemicals
- Personal Protective equipment
- Acute and chronic effects of chemicals
- Waste Disposal
- Clean up procedures
- Safe handling procedures

In the event a large variety of hazardous chemicals are stored or in use, the University may substitute generic training for chemical specific training. The contents of this pamphlet meet, in part, the generic training requirements. Your supervisor will provide additional training as necessary.

The University is required to keep a record of training sessions provided to employees. You may be required to sign a ledger verifying your attendance at a training session.

If you do not understand the material provided or discussed, contact your supervisor or the Environmental Safety Department (3803).

## **MATERIAL SAFETY DATA SHEETS (MSDS)**

A Material Safety Data Sheet (MSDS) is a document, prepared by the manufacturer of the product, indicating the chemical hazard and safe handling information and is prepared in accordance with the OSHA Hazard Communication Standard.

The manufacturer or distributor must provide an appropriate MSDS for each chemical purchased.

If an MSDS is not provided with a shipment of a chemical, a request for one must be sent to the supplier in a timely manner.

The employer must assure the MSDSs on file are current.

Upon request, the employer must make MSDSs available to employees or designated representatives.

The Environmental Safety Department (3803) is the central repository for MSDSs. They are also located department offices of areas of chemical use.

### **MSDS SECTION BY SECTION**

#### ***What is the material and what do I need to know immediately in an emergency?***

##### **SECTION I** Chemical Product and Company Identification:

- Links the MSDS to the material.
- Identifies the supplier of the MSDS.
- Identifies a source for more information, including emergency information, if available.

##### **SECTION II** Composition and Information on Ingredients:

- Lists the Occupational Safety & Health Administration hazardous components.
- May also list significant non-hazardous components.
- Lists corresponding Chemical Abstracts Registry Numbers, where appropriate, for each component.
- May include additional information, such as exposure guidelines, about components.

##### **SECTION III** Hazards Identification:

- Provides information on the potential adverse health effects and symptoms that might result from reasonably foreseeable use and misuse of the material.
- May provide an emergency overview that describes the material's appearance and severe, immediate health, physical, and environmental hazards associated with emergency response situations.

#### ***What should I do if a hazardous situation occurs?***

##### **SECTION IV** First-Aid Measures:

- Provides easily understandable instructions on what to do when results of exposure require immediate treatment and when simple measures may be taken before professional medical assistance is available. Instructions provide for each route of exposure.

##### **SECTION V** Fire-Fighting Measures

- Provides basic fire-fighting guidance, including appropriate extinguishing media.
- Describes other fire and explosive properties useful for fighting fires involving the material such as flash points, explosive limits.

##### **SECTION VI** Accidental Release Measures:

- Describes actions to be taken to minimize the adverse effects of an accidental spill, leak, or release of the material.

#### ***How can I prevent hazardous situations from occurring?***

##### **SECTION VII** Handling and Storage:

- Provides information on appropriate practices for safe handling and storage of the material.

##### **SECTION VIII** Exposure Controls Personal Protection.

- Provides information on practices and/or equipment useful for minimizing worker exposure.
- Provides guidance on personal protection equipment.
- May also include exposure guidelines.

SECTION IX Physical and Chemical Properties:

- Identifies the physical and chemical properties that characterize the material.

SECTION X Stability and Reactivity:

- Describes the conditions that could result in a potentially hazardous chemical reaction.

*Is there any other useful information about this material?*

SECTION XI Toxicological Information:

- May be used to provide information on toxicity testing of the material and/or its components for medical professionals, occupational safety and health professionals and toxicologists.

SECTION XII Ecological Information:

- May be used to provide information on the effects the material may have on plants, animals, and its environmental fate.

SECTION XIII Disposal Considerations:

- May provide information useful to determine appropriate disposal measures.

SECTION XIV Transportation Information:

- May provide basic shipping classification information.

SECTION XV Regulatory information:

- May be used to provide information on state, federal, and international regulations affecting the material or its components.

SECTION XVI Other Information.

## LABELS

A label is any written, printed, or graphic material displayed on or affixed to containers of hazardous materials. Existing labels on containers of hazardous chemicals shall not be removed.

If a hazardous chemical is transferred from an original container to another container, a label shall be placed on the new container identifying the chemical and appropriate hazard warnings. If the chemical is regulated under the federal Insecticide, Fungicide, and Rodenticide Act, or the Arkansas Pesticide Control Act § 2-16-401 et seq., then the chemical name or common name on the original container must be placed on the new container.

A container which chemicals are transferred into for immediate use, by the employee who transferred the chemical, is not required to be labeled. An employee can't work with a chemical in an unlabeled container they did not fill them self.

Read carefully all the information on the label. If you don't understand something, contact your supervisor for an explanation or request a Material Safety Data Sheet (MSDS).

For substances purchased after 1985, the label on the container will indicate if the chemical is hazardous. Words such as: caution, hazardous, toxic, dangerous, corrosive, irritant, carcinogen, suspect carcinogen, etc. indicate the hazard of the product. Products purchased prior to 1985 may not indicate a hazard warning. If you are not sure a chemical you are using, or exposed to, is hazardous, review the MSDS or contact your supervisor or Environmental Safety Department (3803).

Labels must contain the following information:

- contents of the container
- name and address of the manufacturer
- physical and health hazards
- recommended personal protective equipment

## HAZARD LABELING SYSTEM

Arkansas State University uses the Hazardous Material Identification Guide (HMIG) for hazard labeling. If the label doesn't contain a hazard indication, the University must affix a HMIG label to indicate hazard and protective equipment.

The following is an example of a HMIG label:

CHEMICAL NAME	
HEALTH (BLUE)	
FLAMMABILITY (RED)	
REACTIVITY (YELLOW)	
PROTECTIVE EQUIPMENT	

The first (white) section is where the chemical or product name will be printed. The second (blue) section will have a number (0 to 4) indicating the health hazard rating. The third (red) section will have a number (0 to 4) indicating the flammability rating. The fourth (yellow) section will have a number (0 to 4) indicating the reactivity rating. The fifth (white) section will have an alphabetic character (a through k or x) indicating the protective equipment index.

The table to the right indicates the indexes which are placed in the boxes on the right side of the HMIG labels. The numbers and alphabetic characters indicate the hazard or the protective equipment required. The picture next to the alphabetic character represents the PPE needed. The numbers indicate the hazard in ascending order from MINIMAL to EXTREME.

### HEALTH INDEX RATINGS:

- 4 -- EXTREME - Highly toxic material. Will have one or more of the following characteristics:
- On very short exposure could cause death or major residual injury even though prompt medical treatment is given.
  - A known or suspected human carcinogen, a mutagen or teratogen.
- 3 -- SERIOUS - Toxic material. Will have one or more of the following characteristics:
- May cause serious temporary or residual injury on short term exposure even though prompt medical attention is given.
  - A known or suspected small animal carcinogen, mutagen or teratogen.
- 2 -- MODERATE - Moderately toxic material. Will have one or both of the following characteristics:
- Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment is given.
- 1 -- SLIGHT - Slightly toxic material. Will have one or more of the following:
- May cause irritation but only minor residual injury even without treatment.
  - Recognized innocuous materials when used with reasonable care.
- 0 -- MINIMAL - No chemical is without some degree of toxicity.







### FLAMMABILITY INDEX RATINGS:



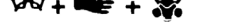
- 4 -- EXTREME - Extremely flammable. Flash point below 73 °F (22.8 °C).
- 3 -- SERIOUS - Flammable. Will have one or more of the following characteristics:
- Vaporizes rapidly and can be ignited under almost all ambient conditions.
  - May form explosive mixtures with or burn rapidly in air.
  - May burn rapidly due to self-contained oxygen.
  - May ignite spontaneously in air.
  - Flash point at or above 73 °F (28.8 °C) but less than 100 °F (37.8 °C).

### Hazardous Materials Identification System








HAZARD INDEX	
4 Severe Hazard	1 Slight Hazard
3 Serious Hazard	0 Minimal Hazard
2 Moderate Hazard	

### PERSONAL PROTECTION INDEX

A	
B	
C	
D	
E	
F	

G	
H	
I	
J	
K	
X	Ask your supervisor for specialized handling directions

© 1981 National Paint & Coatings Association



- 2 -- MODERATE - Combustible. Will have one or more of the following characteristics:
  - Must be moderately heated or exposed to relatively high temperatures for ignition to occur.
  - Solids which readily give off flammable vapors.
  - Flash point at or above 100 °F (37.8 °C) but less than 200 °F (93.4 °C).
- 1 -- SLIGHT - Slightly combustible. Will have one or more of the following characteristics:
  - Must be preheated for ignition to occur.
  - Will burn in air when exposed at 1500 °F (815.5 °C) for five minutes.
  - Flash point at or above 200 °F (93.4 °C).
- 0 -- MINIMAL - Will have one or more of the following characteristics:
  - Will not burn.
  - Will not exhibit a flash point.
  - Will not burn in air when exposed at 1500 °F (815.5 °C) for five minutes.

**REACTIVITY INDEX RATINGS:**

- 4 -- EXTREME - Will have one or more of the following characteristics:
  - Can explode or decompose violently at normal temperature and pressure.
  - Can undergo a violent self-accelerating exothermic reaction with common materials or by itself.
  - May be sensitive to mechanical or local thermal shock at normal temperature and pressure.
- 3 -- SERIOUS - Will have one or more of the following characteristics:
  - Can detonate or explode but requires a strong initiating or confined heating before initiation.
  - Readily promotes oxidation with combustible materials and may cause fires.
  - Is sensitive to thermal or mechanical shock at elevated temperatures.
  - May react explosively with water without requiring heat or confinement.
- 2 -- MODERATE - Will have one or more of the following characteristics:
  - Normally unstable and readily undergoes violent change but does not detonate.
  - May undergo chemical change with rapid release of energy at normal temperature and pressure.
  - May undergo violent change at elevated temperature and pressure.
  - May react violently with water.
  - Forms potentially explosive mixtures with water.
- 1 -- SLIGHT - Will have one or more of the following characteristics:
  - Normally stable material which can become unstable at high temperature and pressure.
  - May react with water to release energy but not violently.
- 0 -- MINIMAL -
  - Normally stable material which is not reactive with water.

**HANDLING CHEMICALS**

- Carefully read the label prior to using a chemical. Review the MSDS to ensure proper handling.
- Do not work alone in a laboratory.
- Use proper personal protective equipment.
- Keep your hands and face clean. Wash thoroughly with soap and water after handling chemicals.
- Avoid direct contact with chemicals.
- Keep chemicals off your hands, face and clothing, and shoes.
- Never smell, inhale or taste a hazardous chemical.
- Smoking, drinking, eating and the application of cosmetics are prohibited in areas of chemical use.
- Do not dispense more chemical than is needed for present use.
- Always use chemicals with proper ventilation as per the MSDS.
- Use chemicals only as directed for their intended purpose.
- Inspect equipment or apparatus for damage before adding a chemical. Do not use damaged equipment.
- Never use mouth suction to fill a pipet. Use a pipet bulb or other pipet filling device.
- Electrically ground and bond containers using approved methods before transferring or dispensing a flammable liquid from a large container.
- For specific information regarding chemical handling, contact your supervisor or the Environmental Safety Department.

## CHEMICAL STORAGE

- Carefully read the label before storing a hazardous chemical. The MSDS will provide any special storage information and incompatibilities.
- Do not store unsegregated chemicals in alphabetical order.
- Do not store incompatible chemicals in close proximity to each other.
- Separate hazardous chemicals in storage as follows:

### Solids:

oxidizers	flammable solids
water reactive	others

### Liquids:

acids	caustics
oxidizers	perchloric acid
flammable/combustible	

### Gases:

toxic	flammable
oxidizers and inert	

- Once separated into hazard classes, chemicals may be stored alphabetically.
- Use approved storage containers and safety cans for flammable liquids.
- Use spill trays under containers of strong reagents.
- Dispose of old chemicals promptly. See waste disposal section of this pamphlet.
- Do not store liquids above eye level.
- Assure all containers are properly labelled.
- For more information on chemical storage, contact your supervisor, or Environmental Safety Department (3803).

## CHEMICAL STABILITY

- Stability refers to the susceptibility of the chemical to dangerous decomposition. Ethers, liquid paraffins, and olefins form peroxides on exposure to air and light. Since these chemicals are packaged in an air atmosphere, peroxides can form even through the containers have not been opened.
- Unless an inhibitor was added by the manufacturer, closed containers of ethers should be discarded after 1 year.
- Open containers of ethers should be discarded within 6 months of opening.
- The label and MSDS will indicate if a chemical is unstable.
- The following are examples of materials which may form explosive peroxides:

Acetal	Cyclohexene
Decahydronaphthalene	Diacetylene
Dicyclopentadiene	Diethyl ether
Diethylene glycol	Dimethyl ether
Dioxane	Divinyl acetylene
Ether (glyme)	Ethylene glycol
Tetrahydronaphthalene	Dimethyl ether
Isopropyl ether	Methyl acetylene
Sodium Amide	Tetrahydrofuran
Vinylidene Chloride	Vinyl ethers
- For additional information on chemical stability, contact your supervisor or the Environmental Safety Department (3803).

## INCOMPATIBLE CHEMICALS

- Certain hazardous chemicals cannot be safely mixed or stored with other chemicals because a severe reaction can take place or an extremely toxic reaction product can result.
- The label and MSDS will contain information on incompatibilities.
- The following is a table containing examples of incompatible chemicals:

<u>Chemical</u>	<u>Keep Out of Contact With:</u>
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, the halogens
Ammonia, Anhydrous	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
Ammonium Nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Bromine	Same as chlorine
Carbon, activated	Calcium hypochlorite, all oxidizing agents
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials
Chromic acid	Acetic acid, naphthalene, camphor, glycerine, turpentine, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals
Chlorine Dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids, organic or inorganic
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrocarbons	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid	Ammonia, aqueous or anhydrous
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, oxidizing, gases
Hydrogen sulfide	Fuming nitric acid, oxidizing gases, acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitric acid	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases
Oxalic acid	Silver, mercury
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids
Potassium permanganate	Glycerine, ethylene glycol, benzaldehyde, sulfuric acid
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerine, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium, etc.) (from Manufacturing Chemists' Association, Guide for Safety in The Chemical Laboratory, pp. 215-217.)

## SHOCK SENSITIVE CHEMICALS

- Shock sensitive refers to the susceptibility of the chemical to rapidly decompose or explode when struck, vibrated or otherwise agitated.
- Some chemicals become increasingly shock sensitive with age. Write the date received and date opened on all containers of shock sensitive chemicals.
- Unless an inhibitor was added by the manufacturer, closed containers of shock sensitive materials should be discarded after 1 year.
- Open containers of shock sensitive materials should be discarded with 6 months of opening.
- The label and MSDS will indicate if a chemical is shock sensitive.
- Wear appropriate personal protective equipment when handling shock sensitive chemicals.
- The following are examples of materials which can be shock sensitive:

Ammonium nitrate	Nitrated carbohydrate
Calcium nitrate	Nitrated glucoside
Dinitroethyleneurea	Nitrated polyhydric alcohol
Dinitrophenol	Nitroglycol
Heavy metal azides	Organic amine nitrates
Lead salts	Organic nitramines
Sodium nitrate- explosive mixtures	Organic peroxides
Potassium	Picramic acid
Trinitrobenzene	Picric acid
Trinitrobenzoic acid compounds	Polynitro aliphatic

## SOLVENTS

- Many of the commonly used solvents are volatile and are harmful when relatively small amounts are inhaled. Most are readily absorbed through the skin. Most are flammable.
- Flammable liquids are more hazardous at elevated temperatures due to more rapid vaporization.
- Electrically ground and bond containers using approved methods before transferring or dispensing a flammable liquid from a large container or drum.
- Purchase only the amount necessary for immediate use.
- Use approved flammable liquid containers and storage cabinets.
- Keep flammable liquids from heat, flame, and direct sunlight.
- Do not store flammable liquids near oxidizing agents such as chromic acid, permanganates, chlorates or perchlorates.
- Avoid skin contact and inhalation of solvents.
- Use assigned personal protective equipment.
- Do not dispose of solvents down sinks or drains.
- Use with adequate ventilation or in a fume hood.

- Common solvents that are relatively toxic include:
  - Aromatic hydrocarbons, especially benzene
  - Esters of acetic or other organic acids
  - Glycols, glycol esters and glycol ethers
  - Halogenated hydrocarbons, Methyl alcohol
  - Nitrogenous bases such as amines
  - Carbon disulfide
- The label and MSDS will indicate any special hazards involving a solvent.
- For additional information, contact your supervisor or Environmental Safety Department (3803).

### **COMPRESSED GASES**

- Carefully read the label before using or storing compressed gas. The MSDS will provide any special hazard information.
- Always use the minimum size cylinder required to perform the work.
- Cylinders of compressed gasses must be handled as high energy sources.
- When storing or moving a cylinder, have the cap securely in place to protect the stem.
- Do not expose cylinders to temperature extremes.
- Always use the correct regulator. Do not use a regulator adaptor.
- Use suitable racks, straps, chains, or stands to support cylinders.
- Cylinders of toxic, flammable or reactive gases should be stored and used in a fume hood or with local ventilation.
- Use an appropriate cart to move cylinders.
- Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out.
- Oil or grease on the high pressure side of an oxygen cylinder can cause an explosion. DO NOT lubricate an oxygen regulator or use a fuel gas regulator on an oxygen cylinder.
- Always wear safety glasses when handling compressed gases.
- For more information, contact your supervisor or Environmental Safety Department (3803).

### **RESTRICTED AREAS**

- Facilities placarded with following warning signs are restricted areas:
  - CAUTION - BIOHAZARDS
  - CANCER HAZARD
  - CAUTION - RADIOACTIVE MATERIAL
  - CAUTION - RADIATION AREA
  - CAUTION - X-RAY
  - CAUTION - LASER
- A list with names and phone numbers of responsible personnel should be posted on the door(s) to any facilities

where hazardous materials are stored or utilized.

- Students, faculty, staff and administrators shall not enter a restricted area, except when accompanied by an authorized user of the facility.
- Custodians are permitted to enter restricted areas to perform routine tasks. However, do not touch labeled waste containers, other research equipment or materials.
- Other support personnel, such as University Security and Physical Plant personnel, etc., are permitted to enter restricted areas provided the work to be performed does not involve disturbing a use area with the facility, equipment or materials.
- Examples include:
  - Fume hoods
  - Sinks
  - Chemical or materials on lab benches
  - Biological safety cabinets
  - Placarded equipment
- Support personnel shall contact an authorized user of the facility or the Environmental Safety Department (3803) before performing work which may involve any of the above items.
- For additional information regarding restricted areas, contact your supervisor or Environmental Safety Department (3803).

## WASTE DISPOSAL

- Hazardous chemical (waste) disposal must be in accordance with procedures established by the Arkansas Department of Pollution Control and Ecology.
- A chemical is defined as a hazardous waste if it is one of the listed chemicals in 40 CFR Ch. I § 261.33, is corrosive (pH > 12.5 or pH < 2.0), or is flammable (flash point > 140 °F) or is reactive.
- Appendix A is a list of the chemicals that OSHA listed as hazardous waste.
- Appendix B is a list of the chemicals that OSHA listed as acute hazardous waste.
- Unless approved by the Environmental Safety Department (3803), disposal of chemicals via the sanitary sewer system is not permitted.
  - ◆ Only water-soluble substances should be disposed of in a laboratory sink.
  - ◆ Solutions of flammable solvents must be sufficiently dilute that they do not pose a fire hazard.
  - ◆ Strong acids and bases should be dilute to pH 3-11 range before they are poured in the sewer system.
  - ◆ Acids and alkalis should not be poured into the sewer at a rate exceeding 50 ml of concentrated substance per min.
  - ◆ Highly toxic, ill smelling, or tear stimulating chemicals should not be disposed of down the drain.
  - ◆ Laboratory drains are generally interconnected; a substance that goes down a sink may come up a vapor in another.
  - ◆ Sinks are usually communal property, and there is a real hazard of chemicals from two sources contacting one another and reacting.
  - ◆ Small amounts of some heavy-metal compounds (Appendix C) may be disposed of in the sink, but larger amounts may pose a hazard for the sewer system or water supply.
- The MSDS should contain special disposal information, if applicable.
- Your department may also have procedures you are required to follow.
- All persons needing a waste pick up will need to fill out a chemical recycle/disposal form (figure 1).

- The following guidelines must be followed:

#### **A. Single Chemical Containers**

1. Do not mix chemicals.
2. Each chemical for disposal must be stored in individual, sealed containers. Only use containers made of materials that are compatible with the chemicals to be stored.
3. Attach a completed waste label if chemical is in a non-recyclable form.
4. Complete a chemical recycle/disposal form.
5. When the container is ready to be picked up contact the Environmental Safety Department with the following:
  - Name of person requesting pickup
  - Building
  - Room Number
  - Name(s) and quantities of chemicals to be picked up
6. Segregate and store chemicals in the area generated according to hazard class and compatibility (See appendix E).

#### **B. Mixed Organic Solvents**

1. Labels for organic solvents should be obtained prior to starting a mixed solvent container.
2. Use approved storage containers for mixed solvents.
3. List the name and volume of each solvent on the label at the time of addition.
4. When the container is full, complete a recycle/disposal form (Do not overfill) (Only mix compatible solvents).
5. When the container is ready to be picked up contact the Environmental Safety Department with the following:
  - Name of person requesting pickup
  - Building
  - Room Number
  - Name(s) and quantities of chemicals to be picked up
6. Segregate and store chemicals in the area generated according to hazard class and compatibility (See appendix E).

#### **C. Chemical Mixtures**

The following guidelines are to be used when disposing of chemical mixtures which are generated as a result of chemical reactions, preparations of solutions, etc.

1. Use approved storage containers for chemical mixtures.
2. List the name and volume of each product on the label at the time of addition.
4. When the container is full, complete a recycle/disposal form (Do not overfill) (Don't mix incompatible products).
5. When the container is ready to be picked up contact the Environmental Safety Department with the following:
  - Name of person requesting pickup
  - Building
  - Room Number
  - Name(s) and quantities of chemicals to be picked up
6. Segregate and store chemicals in the area generated according to hazard class and compatibility (See appendix E).

**(Figure 1)**

**Arkansas State University  
CHEMICAL WASTE DISPOSAL/RECYCLE FORM**

Date \_\_\_\_\_

(1) \_\_\_\_\_  
Name of person Completing form      Tel. Ext.    Building    Room #.

(2) \_\_\_\_\_  
Waste Storage Location

Chemical name or Formula	Generator Name	Type of Haz C-E-F O-P- CAR.-W	Volume (Est.)	Size cont	State **

Specify each hazard which the waste represents in its present form:

C - Corrosive                      O - Oxidizer                      W - Water reactive  
E - Explosive                      P - Poison  
F - Flammable                      CAR - Carcinogen

\*\* Physical State - Solid, Liquid, Gas, Solid/Liquid Mixtures



## CHEMICAL SPILLS

### GENERAL INFORMATION:

Anticipate spills by having the proper safety equipment on hand.

Alert personnel in the area that a spill has occurred.

Do what is necessary to protect life.

The MSDS will contain special spill clean-up information, if applicable.

Confine the spill if possible.

If the spill is too large for you to handle; is a threat to personnel, students or the public; involves an infectious agent; or involves a corrosive, highly toxic, or reactive chemical, call for assistance:

**Environmental Safety Department, 972-3803**

If there is the slightest doubt as to how to proceed, do not hesitate to call for assistance.

For specific spill clean-up information, contact your supervisor or the Environmental Safety Department (3803).

### LOW HAZARD MATERIAL SPILLS:

No fire hazard; not particularly volatile, toxic or corrosive (e.g. salt solutions).

Use an absorbent material that will neutralize the spill if available i.e.

Trisodium phosphate

Sand

Sodium bicarbonate for acids

Powdered citric acid for bases

"Oil-Dri", "Zorb-All", "Speedi-Dri", etc.

Paper towels

A dustpan and brush should be used and rubber gloves and goggles should be worn.

Decontaminated area with soap and water after clean-up.

Place residue in a container for waste collection.

Contact your supervisor or the Environmental Safety Department (3803) for disposal information.

### VOLATILE, FLAMMABLE OR TOXIC MATERIAL SPILLS:

Notify all personnel in the area

Extinguish flames and all sources of ignition such as brush-type motors.

Maintain fume hood ventilation.

Vacate the area and call for assistance.

The following compounds are very hazardous. You should NOT clean them up yourself:

Aromatic amines

Nitro compounds

Nitriles

Bromine

Carbon disulfide

Ethers

Hydrazine

Cyanides

Organic halides

If you spill a highly toxic material, immediately contact the Environmental Safety Department (3803).

### **ACID CHLORIDE SPILLS:**

Absorb spill with "Oil-Dri", "Zorb-All", "Speedi-Dri" or other clay type absorbent.

Avoid contact with skin.

Place residue in container for waste collection.

For specific clean-up information, contact your supervisor or Environmental Safety Department (3803).

### **MERCURY SPILLS:**

Use a trapped vacuum line attached to a tapered glass tube similar to a medicine dropper to pick up mercury droplets.

Do not use a domestic or commercial vacuum cleaner.

Cover small droplets in accessible areas with one of the following:

Sodium polysulfide solution

Powdered sulfur

Silver metal compounds

Place residue in container for waste collection.

For specific clean-up information, contact your supervisor or the Environmental Safety Department (3803).

### **ALKALI METAL SPILLS:**

Smother with powdered graphite or "Met-L-X".

Call for assistance.

For specific clean-up information, contact your supervisor or the Environmental Safety Department (3803).

### **WHITE PHOSPHORUS:**

Smother with wet sand or wet absorbent.

Call for assistance.

For specific clean-up information, contact your supervisor or the Environmental Safety Department (3803).

## **PERSONAL PROTECTION**

### **General Considerations**

Personal protective devices are to be used only where engineering and administrative controls cannot be used or made adequate, or while controls are being instituted.

Engineering and administrative controls to reduce or eliminate exposure to hazardous chemicals are:

substitution of a less hazardous substance

substitution of less hazardous equipment or process

isolation of the operator or process

local and general ventilation (e.g. use of fume hoods)

hazard education

job rotation

The MSDS lists the personal protective equipment recommended for use with the chemical. The MSDS addresses

"worst case" conditions. All equipment listed in the MSDS may not be required for a specific job.

Common sense and standard laboratory procedures should dictate appropriate personal protective equipment for an application. If there is any doubt, after referring to the MSDS, contact your supervisor or the Environmental Safety Department.

Ventilation requirements must be adapted to the work site and the specific process.

### **Protection Against Inhalation Hazards**

Respirators are designed to protect only against certain specific types of substances and in certain concentration ranges, depending on the type of equipment used.

Respirator selection is based on the hazard and the protection factors required.

Types of respiratory protective equipment include:

- Particle-removing air purifying respirators
- Gas and vapor-removing air purifying respirators
- Atmosphere supplying respirators

You should familiarize yourself with the limitations of each type of respiratory protective equipment used and the signals for respirator failure (odor breakthrough, filter clogging, etc.).

Respirators are not to be used except in conjunction with a complete respiratory protection program.

If your work requires the use of a respirator, you will receive special training from your supervisor or the Environmental Safety Department (3803).

Do not use respiratory protective equipment until you have received proper training.

### **Protection of Skin and Body**

Skin and body protection involves protective clothing and includes protection of various parts of the whole body either completely or partially as may be required.

Eye and face injuries are prevented by the use of the following:

- Safety glasses with side shields for dust and flying object protection
- Chemical splash goggles for chemical splash, spray and mist protection
- Face and neck shields for head and neck protection from various hazards (must be used with safety glasses or goggles)

Where there is no immediate danger to the skin from contact with a hazardous chemical, but where it is undesirable to have the employee expose himself in his street clothes, lab coats, coveralls, aprons or protective suits shall be utilized. General categories of contaminants include:

- |                 |                        |
|-----------------|------------------------|
| Dirt and grease | Toxic dust (asbestos)  |
| Lab chemicals   | Bacteriological agents |

These garments should not leave the work site.

For heavily contaminated work, special attention must be given to sealing all openings in the clothing. Tape can be utilized for this purpose. Caps should be worn to protect hair from contamination.

Exposures to strong acids and acid gases, organic chemicals and strong oxidizing agents, etiological agents, carcinogens, and mutagen require the use of protective equipment that prevents skin contamination. Impervious protective equipment must be utilized. Examples include:

- |                  |                              |
|------------------|------------------------------|
| Rubber gloves    | Rubber boots                 |
| Rubberized suits | Special protective equipment |

Protective garments are not equally effective for every hazardous chemical. Some chemicals will "break through" the garment in a very short time. Therefore, garment selection is based on the specific chemical utilized.

General selection criteria is as follows:

*ABI Note. See Governing Principles and Procedures for Laboratory Safety, at <http://www.astate.edu/dotAsset/31ef59c4-1279-4cbb-bee3-0d2a39a9ba5d.pdf>, June 5, 2009, Page 13 (Oct 14, 2014)*

Chemical	Vinyl		Rubber		Synthetic	Natural
	Neoprene	Plastic	Latex	Nitrile	Latex	Latex
	Resistance					
alcohols	E	E	G	E	E	G
caustics	E	E	E	E	E	E
chlorinated solvents	G	F	NR	E	G	NR
ketones	G	NR	G	G	G	G
petroleum solvents	E	G	F	S	E	F
organic acids	E	E	E	E	E	E
inorganic acids	E	E	E	E	E	E
solvents non-chlorinated	G	F	NR	G	G	NR
insecticides	E	E	F	S	E	F
inks	E	E	F	S	E	F
formaldehyde	E	E	E	S	S	E
acrylonitrile	E	G	E	S	E	E
hydraulic fluid	E	E	F	S	E	F
carbon- disulfide	NR	F	G	F	NR	G
paint remover	F	F	NR	E	F	NR

S-SUPERIOR E-EXCELLENT G-GOOD F- FAIR NR- NOT RECOMMENDED

Determine what chemicals are to be used, then contact your supervisor or Environmental Safety Department (3803) for information regarding chemical protective clothing.

## INJURY AND ILLNESS

Employees must notify their immediate supervisor of all illnesses and injuries related to exposure to hazardous chemicals.

If emergency transportation is necessary, (911) should be called to receive transportation for the victim.

Do not move a seriously injured person unless they are in further danger.

In cases of serious injury or illness, it is imperative appropriate actions be followed immediately.

When in doubt as to what should be done, telephone (911) for assistance.

Tell emergency and medical personnel:

- Your name, location and nature of the emergency
- Name of the chemical involved
- The amount involved
- Area of the body effected
- Symptoms

If you have any questions regarding injury and illness procedures, contact your supervisor or the Environmental Safety Department (3803).

## PERSONAL CONTAMINATION

### **GENERAL INFORMATION:**

Do what is necessary to protect life. Remain calm.

The MSDS will contain special first aid information.

Do not move an injured person unless they are in further danger.

A blanket should be used immediately to protect the victim from shock and exposure.

Get medical attention promptly by dialing:

**Jonesboro Fire, Police, Ambulance 911**

For specific instruction regarding personal contamination, contact your supervisor or the Environmental Safety Department (3803).

### **CHEMICALS SPILLED OVER A LARGE AREA OF THE BODY:**

Quickly remove all contaminated clothing while using the safety shower or other available source of water.

Immediately flood the affected body area in cold water for at least 15 minutes.

Wash off chemical with water but DO NOT USE neutralizing chemicals, unguents, creams, lotions or salves.

### **CHEMICALS ON THE SKIN IN CONFINED AREAS:**

Immediately flush with cold water.

If there is no visible burn, remove jewelry to facilitate removal of any residual material and scrub area with warm water and soap, removing any jewelry to facilitate removal of any residual material.

If a delayed action is noted (often the next day), report immediately for medical attention and explain carefully what chemicals were involved.

If the incident involves HYDROFLUORIC ACID (HF), seek immediate medical attention.

If there is any doubt, seek immediate medical attention.

### **CHEMICALS IN THE EYES:**

Irrigate with plenty of cool water for at least 15 minutes. Use eyewash or other water source.

Simultaneously check for and remove contact lenses.

Get medical attention promptly.

### **SMOKE AND FUMES:**

Anyone overcome with smoke or chemical fumes should be removed to uncontaminated air and treated for shock.

Do not enter the area if a life threatening condition still exists:

Oxygen depletion

Explosive vapors

Cyanide gas, hydrogen sulfide, nitrogen oxides, carbon monoxide

If certified, follow standard CPR protocols.

Get medical attention promptly.

### **BURNING CHEMICALS ON CLOTHING:**

Extinguish burning clothing by using the drop-and-roll technique or by dousing with cold water or use emergency shower.

Remove contaminated clothing; however, avoid further damage to the burned area. If possible, send clothing with the victim.

Remove heat with cool water or ice packs until tissue around burn feels normal to the touch.

Cover injured person to prevent shock. Get medical attention promptly.

### **INGESTION OF HAZARDOUS CHEMICALS:**

Identify the chemical ingested.

Call for ambulance (911)

Cover injured person to prevent shock.

Provide the ambulance crew and physician with the chemical name and any other relevant information. If possible, send the container or the label with the victim.

### **CHEMICAL TOXICITY:**

Toxicity is the study of the nature and action of poisons.

Toxicity is the ability of a chemical molecule or compound to produce injury once it reaches a susceptible site in or the body.

Toxicity hazard is the probability that injury will occur considering the manner in which the substance is used.

## **DOSE-RESPONSE RELATIONSHIPS:**

The potential toxicity (harmful action) inherent in a substance is manifest only when that substance comes in contact with a living biological system. A chemical normally thought of with a living bio-logical system. A chemical normally thought of as "harmless" will evoke a toxic response if added to a biological system in sufficient amount. The toxic potency of a chemical is thus ultimately defined by the relationship between the dose (the amount) of the chemical and the response that is produced in a biological system.

## **ROUTES OF ENTRY INTO THE BODY:**

There are three main routes by which hazardous chemicals enter the body:

**Absorption through the RESPIRATORY TRACT through inhalation.** Most important in terms of severity.

**Absorption through the SKIN.** Runs first in the production of occupational disease (dermatitis).

**Absorption through the DIGESTIVE TRACT.** Can occur through eating or smoking with contaminated hands or in contaminated work areas.

Most exposure standards, Threshold Limit Values (TLVs) and Permissible Exposure Limits (PELs), are based on the inhalation route of exposure. They are normally expressed in terms of either parts per million (ppm) or milligrams per cubic meter (mg/m<sup>3</sup>) concentration in air.

If a significant route of exposure for a substance is through skin contact, the MSDS will have a "skin" notation. Examples: pesticides, carbon disulfide, carbon tetrachloride, dioxane, mercury, thallium compounds, xylene, hydrogen cyanide.

## **TYPES OF EFFECTS:**

ACUTE POISONING is characterized by rapid absorption of the substance and the exposure is sudden and severe. Normally, a single large exposure is involved. Examples: carbon monoxide or cyanide poisoning.

CHRONIC POISONING is characterized by prolonged or repeated exposures of a duration measured in days, months or years. Symptoms may not be immediately apparent. Examples: lead or mercury poisoning, pesticide exposure.

LOCAL refers to the site of action of an agent and means the action takes place at the point or area of contact. The site may be skin, mucous membranes, the respiratory tract, gastro-intestinal system, eyes, etc. Absorption does not necessarily occur. Examples: strong acids or alkalis and war gases.

SYSTEMIC refers to a site of action other than the point of contact and the presupposes absorption has taken place. For example, and inhaled material may act on the liver. Examples: arsenic affects the blood, nervous system, liver, kidneys and skin; benzene affects bone marrow.

CUMULATIVE POISONS are characterized by materials that tend to build up in the body as a result of numerous chronic exposures. The effects are not seen until a critical body burden is reached. Example: heavy metals.

SUBSTANCES IN COMBINATION: When two or more hazardous materials are present at the same time, the resulting effect can be greater than the effect predicted based on the individual substances. This is called a SYNERGISTIC or POTENTIATING EFFECT. Example: exposure to alcohol and chlorinated solvents.

## **OTHER FACTORS AFFECTING TOXICITY:**

Rate of entry and route of exposure; that is, how fast is the toxic dose delivered and by what means.

Age can effect the capacity to repair tissue damage.

Previous exposure can lead to tolerance, increased sensitivity or make no difference.

State of health, physical condition and life style can affect the toxic response. Pre-existing disease can result in increased sensitivity.

Environmental factors such as temperature and pressure.

Host factors including genetic predisposition and the sex of the exposed individual.

## CLASSIFICATION OF TOXIC MATERIALS

### PHYSICAL CLASSIFICATIONS:

GAS applies to a substance which is in the gaseous state at room temperature and pressure.

A VAPOR is the gaseous phase of a material which is ordinarily a solid or a liquid at room temperature and pressure.

When considering the toxicity of gases and vapors, the solubility of the substance is a key factor. Highly soluble materials like ammonia irritate the upper respiratory tract. On the other hand, relatively insoluble materials like nitrogen dioxide penetrate deep into the lung. Fat soluble materials, like pesticides, tend to have longer residence times in the body.

An AEROSOL is composed of solid or liquid particles of micro-scopic size dispersed in a gaseous medium. The toxic potential of an aerosol is only partially described by its concentration in milligrams per cubic meter (mg/m<sup>3</sup>). For a proper assessment of the toxic hazard, the size of the aerosol's particles is important. Particles above 1 micrometer tend to deposit in the upper respiratory tract. Below 1 micrometer particles enter the lung. Very small particles (<0.2 μm) are generally not deposited.

### PHYSIOLOGICAL CLASSIFICATIONS:

**IRRITANTS** are materials that cause inflammation of mucous membranes with which they come in contact. Inflammation of tissue results from concentrations far below those needed to cause corrosion. Examples include:

Ammonia	Alkaline dusts and mists
Hydrogen chloride	Hydrogen fluoride
Halogens	Ozone
Phosgene	Diethyl/dimethyl sulfate
Nitrogen dioxide	Phosphorus chlorides
Arsenic trichloride	

Irritants can also cause changes in the mechanics of respiration and lung function. Examples include:

Sulfur dioxide	Acetic acid
Formaldehyde	Formic acid
Sulfuric acid	Acrolein
Iodine	

Long term exposure to irritants can result in increased mucous secretions and chronic bronchitis.

A PRIMARY IRRITANT exerts to systemic toxic action either because the products formed on the tissue of the respiratory tract are non-toxic or because the irritant action is far in excess of any systemic toxic action. Example: hydrogen chloride.

A SECONDARY IRRITANT's effect on mucous membranes is over-shadowed by a systemic effect resulting from absorption. Examples include:

Hydrogen sulfide	Aromatic Hydrocarbons
------------------	-----------------------

Exposure to a secondary irritant can result in pulmonary edema, hemorrhage and tissue necrosis.



**ASPHYXIANTS** have the ability to deprive tissue of oxygen.

**SIMPLE ASPHYXIANTS** are inert gases that displace oxygen. Examples include:

Nitrogen	Nitrous oxide	Carbon dioxide
Hydrogen	Helium	

**CHEMICAL ASPHYXIANTS** have as their specific toxic action rendering the body incapable of utilizing an adequate oxygen supply. They are active at very low concentrations (few ppm). Examples include: Carbon monoxide and Cyanides

**PRIMARY ANESTHETICS** have a depressant effect upon the central nervous system, particularly the brain. Examples include: Halogenated hydrocarbons, Alcohols

**HEPATOTOXIC AGENTS** cause damage to the liver. Examples include: Carbon tetrachloride, Nitrosamines, Tetrachloroethane

**NEPHROTOXIC AGENTS** damage the kidneys. Examples include: Halogenated hydrocarbons, Uranium compounds

**NEUROTOXIC AGENTS** damage the nervous system. The nervous system is especially sensitive to organometallic compounds and certain sulfide compounds. Examples include:

Trialkyl tin compounds	Tetraethyl lead
Methyl mercury	Carbon disulfide
Manganese	Thallium
Organic phosphorus insecticides	

Some toxic agents act on the **BLOOD or HEMATOPOIETIC SYSTEM**. The blood cells can be directly affected or bone marrow can be damaged. Examples include:

Nitrites	Aniline
Toluidine	Nitrobenzene
Benzene	

There are toxic agents that produce damage of the **PULMONARY TISSUE (lungs)** but not by immediate irritant action. Fibrotic changes can be caused by free silica and asbestos. Other dusts can cause a restrictive disease called PNEUMOCONIOSIS. Examples include:

Coal dust	Cotton dust	Wood dust
-----------	-------------	-----------

A **CARCINOGEN** commonly describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or that possesses such material. Known human carcinogens include:

Asbestos	4-Nitrobiphenyl
Alpha-naphthylamine	Methyl chloromethyl ether
3,3'-dichlorobenzidine	Bis-chloromethyl ether
Vinyl chloride	Inorganic arsenic
Ethylene oxide	1,2-dibromo-3-chloropropane (DBCP)
N-nirosodimethylamine	
Coal tar pitch volatiles	

A **MUTAGEN** affects the chromosome chains of exposed cells. The effect is hereditary and becomes part of the genetic pool passed on to future generations.

A **TERATOGEN** (embryotoxic or fetotoxic agent) is an agent which interferes with normal embryonic development without damage to the mother or lethal effect on the fetus. Effects are not hereditary. Examples include:

Lead	Dibromo dichloropropane
------	-------------------------

A **SENSITIZE** causes a substantial proportion of exposed people to develop an allergic reaction in normal tissue after repeated exposure to the chemical. The reaction may be as mild as a rash (contact dermatitis) or as serious as anaphylactic shock. Examples include:

Epoxies	Nickel Compounds
Poison ivy	Toluene diisocyanate
Chromium compounds	Chlorinated hydrocarbons

## TARGET ORGAN EFFECTS

The following is a target organ categorization of effects which may occur, including examples of signs and symptoms and chemicals which have been found to cause such effects.

<b>Hepatotoxics</b> Signs and symptoms Example chemicals	Causes liver damage Jaundice; liver enlargement Carbon tetrachloride, nitrosamines, chloroform, toluene, perchloroethylene, cresol, dimethylsulfate
<b>Nephrotoxics</b> Signs and symptoms Example chemicals	Produce kidney damage Edema; proteinuria Halogenated hydrocarbons, uranium, chloroform, mercury, dimethylsulfate
<b>Neurotoxins</b> Signs and symptoms Example chemicals	Affect the nervous system Narcosis; behavioral changes; decreased muscle coordination Mercury, carbon disulfide, benzene, carbon tetrachloride, lead, mercury, nitrobenzene
<b>Hematopoietic Agents</b> Signs and symptoms Example chemicals	Decreased blood functions Cyanosis; loss of consciousness Carbon monoxide, cyanides, nitrobenzene, aniline, arsenic, benzene, toluene
<b>Pulmonary Agents</b> Signs and symptoms Example chemicals	Irritate or damage the lungs Cough; tightness in chest, shortness of breath Silica, asbestos, ozone, hydrogen
<b>Reproductive toxins</b> Signs and symptoms Example chemicals	Affect the reproductive system (mutations and teratogenesis) Birth defects; sterility Lead, dibromo dichloropropane
<b>Skin hazards</b> Signs and symptoms Example chemicals	Affect the dermal layer of the body Defatting of skin; rashes; irritation Ketones, chlorinated compounds, alcohols, nickel, phenol, trichloroethylene
<b>Eye hazards</b> Signs and symptoms Example chemicals	Affect the eye or vision Conjunctivitis; Corneal damage Organic solvents, acids, cresol, quinone, hydroquinone, benzol chloride, butyl alcohol, bases

## HYGIENIC STANDARDS

**TLV:** The THRESHOLD LIMIT VALUE is a recommended occupational exposure standard published by the American Conference of Governmental Industrial Hygienists. TLV's are expressed as parts of vapor or gas per million parts of air by volume (ppm) or as approximate milligrams of particulate per cubic meter of air (mg/m<sup>3</sup>). The TLV is the average concentration of a chemical that is thought most people can be exposed to for a working lifetime with no ill effects. The TLV is an advisory guideline. If applicable, a CEILING CONCENTRATION (C) which should not be exceeded or a SKIN HAZARD (S) will be indicated with the TLV.

**PEL:** The PERMISSIBLE EXPOSURE LIMIT is a legal standard issued by OSHA. Unless specified, the PEL is a Time Weighted Average (TWA).

**TWA:** Most exposure standards are based on time weighted averages. The TWA is based on the average exposure weighted for an 8 hour work day. CEILING LIMIT (C) and acceptable maximum peaks above the average must be considered when exposures are evaluated.

The **MSDS** will list the hygienic standard for the hazardous chemical or each component of a mixture.

The Environmental Safety Department has a complete listing of published TLVs and PELs and other works concerning the subject of industrial toxicology. If you would like to conduct a more thorough review of a particular compound, contact the Environmental Safety Department.

## APPENDICES

### APPENDIX A. EPA LISTED HAZARDOUS WASTES (1993)

*ABI Note. See <http://www.epa.gov/osw/hazard/wastetypes/pdfs/listing-ref.pdf> (Oct 14, 2014)*

Haz Waste #	CAS #	Substance
U001	75070	Acetaldehyde (I)
U034	75876	Acetaldehyde, trichloro-
U187	62442	Acetamide, N-(4-ethoxyphenyl)-
U005	53963	Acetamide, N-9H-fluren-2-yl-
U240	94757	Acetic acid, (2,4-dichlorophenoxy)-, salts & esters
U112	141786	Acetic acid ethyl ester (I)
U144	301042	Acetic acid, lead(2+) salt
U214	563688	Acetic acid, thallium(1+) salt
F027*	93765	Acetic acid, (2,4,5-trichlorophenoxy)-
U002	67641	Acetone (I)
U003	75058	Acetonitrile (I,T)
U004	98862	Acetophenone
U005	53693	2-Acetylaminofluorene
U006	75365	Acetyl chloride (C,R,T)
U007	79061	Acrylamide
U008	79107	Acrylic acid (I)
U009	107131	Acrylonitrile
U011	61825	Amitrole
U012	62533	Aniline (I,T)
U136	75605	Arsinic acid, dimethyl-
U014	492808	Auramine
U015	115026	Azaserine
U010	50077	Azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione,6-amino-8- [[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl- ,[1aS-(1a $\alpha$ ,8 $\beta$ ,8a $\alpha$ ,8b $\alpha$ )]-
U157	56495	Benz[j]aceanthrene, 1,2-dihydro-3-methyl-
U016	225514	Benz[c]acridine
U017	98873	Benzal chloride

U192	23950585	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
U018	56553	Benz[a]anthracene
U094	57976	Benz[a]anthracene, 7,12-dimethyl-
U012	62533	Benzenamine (I,T)
U014	492808	Benzenamine, 4,4'-carbonimidoylbis[N,N-dimethyl
U049	3165933	Benzenamine, 4-chloro-2-methyl-, hydrichloride
U093	60117	Benzenamine, N,N-dimethyl-4(phenylazo)-
U328	95534	Benzenamine, 2-methyl-
U353	106490	Benzenamine, 4-methyl-
U158	101144	Benzenamine, 4,4'-methylenebis[2-chloro-
U222	636215	Benzenamine, 2-methyl-, hydrochloride
U181	199558	Benzenamine, 2-methyl-5-nitro-
U019	71432	Benzene (I,T)
U038	510156	Benzenoacetic acid, 4-chloro- <b>alpha</b> -(4-chlorophenyl)- <b>alpha</b> -hydroxy-, ethyl ester
U030	101553	Benzene, 1-bromo-4-phenoxy-
U035	305033	Benzenobutanoic acid, 4-[bis(2-chloroethyl)amino]-
U037	108907	Benzene, chloro-
U221	25376458	Benzenediamine, ar-methyl-
U028	117817	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
U069	84742	1,2-Benzenedicarboxylic acid, dibutyl ester
U088	84662	1,2-Benzenedicarboxylic acid, diethyl ester
U102	131113	1,2-Benzenedicarboxylic acid, dimethyl ester
U107	117840	1,2-Benzenedicarboxylic acid, Dioctyl ester
U070	95501	Benzene, 1,2-dichloro-
U071	541731	Benzene, 1,3-dichloro-
U072	106467	Benzene, 1,4-dichloro-
U060	72548	Benzene, 1,1'-(2,2-dichloroethylidene)bis [4-chloro-
U017	98873	Benzene, (dichloromethyl)-
U223	26471625	Benzene, 1,3-diisocyanatomethyl- (R,T)
U239	1330207	Benzene, Dimethyl- (I,T)
U201	108463	1,3-Benzenediol
U127	118741	Benzene, hexachloro-

U056	110827	Benzene, hexahydro- (I)
U220	108883	Benzene, methyl-
U105	121142	Benzene, 1-methyl-2,4-dinitro-
U106	606202	Benzene, 2-methyl-1,3-dinitro-
U055	98828	Benzene, (1-methylethyl)- (I)
U169	98953	Benzene, nitro-
U183	608935	Benzene, pentachloro-
U185	82688	Benzene, pentachloronitro-
U020	98099	Benzenesulfonic acid chloride (C,R)
U020	98099	Benzenesulfonyl chloride (C,R)
U207	95943	Benzene, 1,2,4,5-tetrachloro-
U061	50293	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis [4-chloro-
U247	72435	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis [4-methoxy-
U023	98077	Benzene, (trichloromethyl)-
U234	99354	Benzene, 1,3,5-trinitro-
U021	92875	Benzidine
U202	181072	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide, & salts
U202	94597	1,3-Benzodioxole, 5-(2-propenyl)-
U141	120581	1,3-Benzodioxole, 5-(1-propenyl)-
U090	94586	1,3-Benzodioxole, 5-propyl-
U064	189559	Benzo[rs]pentaphene
U248	81812	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl-butyl)- & salts {conc. 0.3% or less}
U022	50328	Benzo[a]pyrene
U197	106514	p-Benzaquinone
U023	98077	Benzotrichloride (C,R,T)
U085	1464535	2,2'-Bioxirane
U021	92875	[1,1'-Biphenyl]-4,4'-diamine
U073	91941	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-
U091	119904	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethoxy-
U095	119937	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-
U225	75252	Bromoform
U030	101553	4-Bromophenyl phenyl ether

U128	87683	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U172	924163	1-Butanamine, N-butyl-N-nitroso-
U031	71363	1-Butanol (I)
U159	78933	2-Butanone (I,T)
U160	1338234	2-Butanone, peroxide (R,T)
U053	4170303	2-Butenal
U074	764410	2-Butene, 1,4-dichloro- (I,T)
U143	303344	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy-...2-(1-methoxyethyl)-3-methyl-1-oxobutoxy] methyl]-...2,3,5,7 a-t etrahydro-1H-pyrrolizin-1-yl ester,...[1S-[1 $\alpha$ (Z)7(2S*,3R*),7a $\alpha$ ]]-
U031	71363	n-Butyl alcohol (I)
U136	75605	Cacodylic acid
U032	13765190	Calcium chromate
U238	51796	Carbamic acid, ethyl ester
U178	615532	Carbamic acid, methylnitroso-, ethyl ester
U097	79447	Carbamic chloride, dimethyl-
U114	111546	Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters
U062	2303164	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester
U215	6533739	Carbonic acid, dithallium(1+) salt
U033	353504	Carbonic difluoride
U156	79221	Carbonochloric acid, methyl ester (I,T)
U033	353504	Carbon oxyfluoride (R,T)
U211	56235	Carbon tetrachloride
U034	75876	Chloral
U035	305033	Chlorambucil
U036	57749	Chlordane, $\alpha$ & $\gamma$ isomers
U026	494031	Chlornaphazin
U073	108907	Chlorobenzene
U038	510156	Chlorobenzilate
U039	59507	p-Chloro-m-cresol
U042	1104758	2-Chloroethyl vinyl ether
U044	67663	Chloroform
U046	107302	Chloromethyl methyl ether

U047	91587	β-Chloronaphthalene
U048	95578	o-Chlorophenol
U049	3165933	4-Chloro-o-toluidine, hydrochloride
U032	13765190	Chromic acid, calcium salt
U050	218019	Chrysene
U051		Creosote
U052	1319773	Cresol (Cresylic acid)
U053	4170303	Crotonaldehyde
U055	98828	Cumene (I)
U246	506683	Cyanogen bromide (CN)Br
U197	106514	2,5-Cyclohexadiene-1,4-dione
U056	110827	Cyclohexane (I)
U129	58899	Cyclohexane, 1,2,3,4,5,6-hexachloro-,...(1α,2α,3β,4α,5α,6β)-
U057	108941	Cyclohexanone (I)
U130	77474	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
U058	50180	Cyclophosphamide
U240	94757	2,4-D, salts & esters
U059	20830813	Daunomycin
U060	72548	DDD
U061	50293	DDT
U062	2303164	Diallate
U063	53703	Dibenz[a,h]anthracene
U064	189559	Dibenzo[a,i]pyrene
U066	96128	1,2-Dibromo-3-chloropropane
U069	84742	Dibutyl phthalate
U070	95501	o-Dichlorobenzene
U071	541731	m-Dichlorobenzene
U072	106467	p-Dichlorobenzene
U073	91941	3,3'-Dichlorobenzidine
U074	764410	1,4-Dichloro-2-butene (I,T)
U075	75718	Dichlorodifluoromethane
U078	75354	1,1-Dichloroethylene



U079	156605	1,2-Dichloroethylene
U025	111444	Dichloroethyl ether
U027	108601	Dichloroisopropyl ether
U024	111911	Dichloromethoxy ethane
U081	120832	2,4-Dichlorophenol
U082	87650	2,6-Dichlorophenol
U084	542756	1,3-Dichloropropene
U085	1464535	1,2:3,4-Diepoxbutane (I,T)
U108	123911	1,4-Diethyleneoxide
U028	117817	Diethylhexyl phthalate
U086	1615801	N,N'-Diethylhydrazine
U087	3288582	O,O-Diethyl S-methyl dithiophosphate
U088	84662	Diethyl phthalate
U089	56531	Diethylstibesterol
U090	94586	Dihydrosafrole
U091	119904	3,3'-Dimethoxybenzidine
U092	124403	Dimethylamine (I)
U093	60117	p-Dimethylaminoazobenzene
U094	57976	7,12-Dimethylbenz[a]anthracene
U095	119937	3,3'-Dimethylbenzidine
U096	80159	alpha,alpha,-Dimethylbenzylhydroperoxide (R)
U097	79447	Dimethylcarbamoyl chloride
U098	57147	1,1-Dimethylhydrazine
U099	540738	1,2-Dimethylhydrazine
U101	105678	2,4-Dimethylphenol
U102	131113	Dimethyl phthalate
U103	77781	Dimethyl sulfate
U105	121142	2,4-Dinitrotoluene
U106	606202	2,6-Dinitrotoluene
U107	117840	Di-n-octyl phthalate
U108	123911	1,4-Dioxane
U109	122667	1,2-Diphenylhydrazine

U110	142847	Dipropylamine (I)
U111	621647	Di-n-propylnitrosamine
U041	106898	Epichlorohydrin
U001	75070	Ethanal (I)
U174	55185	Ethanamine, (N-ethyl-N-nitroso-
U155	91805	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-
U067	106934	Ethane, 1,2-dibromo-
U076	75343	Ethane, 1,1-dichloro-
U077	107062	Ethane, 1,2-dichloro-
U131	67731	Ethane, hexachloro-
U024	111911	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-
U117	60297	Ethane, 111'-oxybis- (I)
U025	111444	Ethane, 1,1'-oxybis[2-chloro-
U184	76017	Ethane, pentachloro-
U208	630206	Ethane, 1,1,1,2-tetrachloro-
U209	79345	Ethane, 1,1,2,2-tetrachloro-
U218	62555	Ethanethioamide
U226	71556	Ethane, 1,1,1-trichloro-
U227	79005	Ethane, 1,1,2-trichloro-
U359	110805	Ethanol, 2-ethoxy-
U173	1116547	Ethanol, 2,2'-(nitrosoimino)bis-
U004	98862	Ethanone, 1-phenyl-
U043	75014	Ethene, chloro-
U042	110758	Ethene, (2-chloroethoxy)-
U078	75354	Ethene, 1,1-dichloro-
U079	156605	Ethene, 1,2-dichloro-, (E)-
U210	127184	Ethene, tetrachloro-
U228	79016	Ethene, trichloro-
U112	141786	Ethyl acetate (I)
U113	140885	Ethyl acrylate (I)
U238	51796	Ethyl carbamate (urethane)
U117	60297	Ethyl ether (I)

U114	111546	Ethylenebisdithiocarbamic acid, salts & esters
U067	106934	Ethylene dibromide
U077	107062	Ethylene dichloride
U359	110805	Ethylene glycol monoethyl ether
U115	75218	Ethylene oxide, (I,T)
U116	96457	Ethylenethiourea
U076	75242	Ethylene dichloride
U118	97632	Ethyl methacrylate
U119	62500	Ethyl methanesulfonate
U120	206440	Fluoranthene
U122	50000	Formaldehyde
U123	64186	Formic acid (C,T)
U124	110009	Furan (I)
U125	98011	2-Furancarboxaldehyde (I)
U147	108316	2,5-Furandione
U213	109999	Furan, tetrahydrol- (I)
U125	98011	Furfural (I)
U124	110009	Furfuran (I)
U206	18883664	Glucopyranose, 2-deoxy-2-(3methyl-3- nitrosoureido)-, D-
U206	18883664	D-Glucose, 2-deoxy-2-[[[(methylnitrosoamino)-... carbonyl]amino]-
U126	765344	Glycidyaldehyde
U163	70257	Guanidine, N-methyl-N'-nitro-N-nitroso-
U127	118741	Hexachlorobenzene
U128	87683	Hexachlorobutadiene
U130	77474	Hexachlorocyclopentadiene
U131	67721	Hexachloroethane
U132	70304	Hexachlorophene
U243	1888717	Hexachloropropene
U133	302012	Hydrazine (R,T)
U086	1615801	Hydrazine, 1,2-diethyl-
U098	57147	Hydrazine, 1,1-dimethyl-
U099	540738	Hydrazine, 1,2-dimethyl-

U109	122667	Hydrazine, 1,2-diphenyl-
U134	7664393	Hydrofluoric acid (C,T)
U134	7661393	Hydrogen fluoride (C,T)
U135	7783064	Hydrogen sulfide
U096	80159	Hydroperoxide, 1-methyl-1-phenylethyl- (R)
U116	96457	2-Imidazolidinethione
U137	193395	Indeno[1,2,3-cd]pyrene
U190	85449	1,3-Isobenzofurandione
U140	78831	Isobutyl alcohol (I,T)
U141	120581	Isosafrole
U142	143500	Kepone
U143	303344	Lasiocarpine
U144	301042	Lead acetate
U146	1335326	Lead, bis(aceto-O)tetrahydroxytri-
U145	7446277	Lead phosphate
U146	1335326	Lead subacetate
U129	58899	Lindane
U163	70257	MNNG
U147	108316	Maleic anhydride
I148	123331	Maleic hydrazide
U149	109773	Malononitrile
U150	148823	Melphalan
U151	7439976	Mercury
U152	126987	Methacrylonitrile (I,T)
U092	124403	Methanamine, N-methyl- (I)
U029	74839	Methane, bromo-
U045	74873	Methane, chloro- (I,T)
U046	107302	Methane, chloromethoxy-
U068	74953	Methane, dibromo-
U080	75092	Methane, dichloro-
U075	75718	Methane, dichlorodifluoro-
U138	74884	Methane, iodo-

U119	62500	Methanesulfonic acid, ethyl ester
U211	56235	Methane, tetrachloro-
U153	74931	Methanethiol (I,T)
U225	75252	Methane, tribromo-
U044	67663	Methane, trichloro-
U121	75694	Methane, trichlorofluoro-
U036	57749	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3a,4,7,7a-hexahydro-
U154	67561	Methanol (I)
U155	91805	Methapyrilene
U142	143500	1,3,4-Metheno-2H-cyclobuta [cd]pentalene-2-one,1,1a,3,3a,4,5,5a,5b,6-decachlorocathydro-
U247	72435	Methoxychlor
U154	67561	Methyl alcohol (I)
U029	74839	Methyl bromide
U186	504609	1-Methylbutadine (I)
U045	74873	Methyl chloride (I,T)
U156	79221	Methyl chlorocarbonate (I,T)
U226	71556	Methyl chloroform
U157	56495	3-Methylcholanthrene
U158	101144	4,4'-Methylenebis(2-chloroaniline)
U068	74953	Methylene bromide
U080	75092	Methylene chloride
U159	78933	Methyl ethyl ketone (MEK) (I,T)
U160	1338234	Methyl ethyl ketone peroxide (R,T)
U138	74884	Methyl iodide
U161	108101	Methyl isobutyl ketone (I)
U162	80626	Methyl methacrylate (I,T)
U161	108101	4-Methyl-2-pentanone (I)
U164	56042	Methylthiouracil
U010	50077	Mitomycin C
U059	20830813	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino 2,3,6-trideoxy)-alpha-L-lyxohexopyranosyl oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8s-cis)
U167	134327	1-Naphthalenamine

U168	91598	2-Naphthalenamine
U026	494031	Naphthalenamine, N,N'-bis(2-chloroethyl)-
U165	91203	Naphthalene
U047	91587	Naphthalene, 2-chloro-
U166	130154	1,4-Naphthalenedione
U236	72571	2,7-Naphthalenedisulfonic acid,3,3'-[(3,3'-...dimethyl [1,1'-biphenyl]-4,4'-diyl)bis(azo)bis[5-amino-4-hydroxy]-, tetrasodium salt
U166	130154	1,4-Naphthoquinone
U167	134327	alpha-Naphthylamine
U168	91598	beta-Naphthylamine
U217	10102451	Nutric acid, thallium(1+)salt
U169	98953	Nitrobenzene (I,T)
U170	100027	P-Nitrophenol
U171	79469	2-Nitropropane (I,T)
U172	924163	N-Nitrosodi-n-butylamine
U173	1116547	N-Nitrosodiethanolamine
U174	55185	N-Nitrosodiethylamine
U176	759739	N-Nitroso-N-ethylurea
U177	684935	N-Nitroso-N-methylurea
U178	615532	N-Nitroso-N-methylurethane
U179	100754	N-Nitrosopiperidine
U180	930552	N-Nitrosopyrrolidine
U181	99558	5-Nitro-O-toluidine
U193	1120714	1,2-Oxanthiolane, 2,2-dioxide
U058	50180	2H-1,3,2-Oxazaphosphorin-2-amine...N,N-bis(2-chloroethyl)te tahydro-, 2-oxide
U115	75218	Oxirane (I,T)
U126	765344	Oxiranecarboxyaldehyde
U041	106898	Oxirane, (chloromethyl)-
U182	123637	Paraldehyde
U183	608935	Pentachlorobenzene
U184	76017	Pentachloroethane
U185	82688	Pentachloronitrobenzene (PCNB)
F027*	87865	Pentachlorophenol

U161	108101	Pentanol, 4-Methyl-
U186	504609	1,3-Pentadiene (I)
U187	62442	Phenacetin
U188	108952	Phenol
U048	95578	Phenol, 2-chloro-
U039	59507	Phenol, 4-chloro-3-methyl-
U081	120832	Phenol, 2,4-dichloro-
U082	87650	Phenol, 2,6-dichloro-
U089	56531	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-
U101	105679	Phenol,2,4-dimethyl-
U052	1319773	Phenol,methyl-
U132	70304	Phenol,2,2'-methylenebis[3,4,6-trichloro-
U170	100027	Phenol, 4-Nitro-
F027*	87865	Phenol, pentachloro
F027*	58902	Phenol, 2,3,4,6-tetrachloro-
F027*	95954	Phenol, 2,4,5-trichloro-
F027*	88062	Phenol, 2,4,6-trichloro-
U150	148823	L-Phenylalanine, 4-[bis(2-chloroethyl)aminol]
U145	7446277	Phosphoric acid, lead (2+) salt (2:3)
U087	3288582	Phosphorodithioic acid, O,O-diethyl S-methyl ester
U189	1314803	Phosphrus sulfide (R)
U190	85449	Phthalic anhydride
U191	109068	2-Picoline
U179	100754	Piperidine, 1-nitroso-
U192	23950585	Pronamide
U194	107108	1-Propanamine (I,T)
U111	621647	1-Propanamine, N-nitroso-N-propyl-
U110	142847	1-Propanamine, N-propyl- (I)
U066	96128	Propane, 1,2-dibromo-3-chloro-
U083	78875	Propane, 1,2-dichloro-
U149	109773	Propanedinitrile
U171	79469	Propane, 2-nitro- (I,T)

U027	108601	Propane, 2,2'-oxybis[2-chloro-
U193	1120714	1,3-Propane sultone
F027*	93721	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-
U235	126727	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U140	78831	1-Propanol, 2-methyl- (I,T)
U002	67641	2-Propanone (I)
U007	79061	2-Propanamide
U084	542756	1-Propene, 1,3-dichloro-
U243	1888717	1-Propene, 1,1,2,3,3,3-hexachloro-
U009	107131	2-Propenenitrile
U152	156987	2-Propenenitrile, 2-methyl- (I,T)
U008	79107	2-Propanoic acid (I)
U113	140885	2-Propanoic acid, ethyl ester (I)
U118	97632	2-Propanoic acid, 2-methyl-, ethyl ester
U162	80626	2-Propanoic acid, 2-methyl-, methyl ester (I,T)
U194	107108	n-Propylamine (I,T)
U083	78875	Propylene dichloride
U148	123331	3,6-Pyridazinedione, 1,2-dihydro-
U196	110861	Pyridine
U191	109068	Pyridine, 2-methyl-
U237	66751	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-...chloroethyl)amino]-
U164	56042	4(1H)-Pyrimidione, 2,3-dihydro-6-methyl-2-thioxo-
U180	930552	Pyrrolidine, 1-nitroso-
U200	50555	Reserpine
U201	108463	Resorcinol
U202	81072	Saccharin, & salts
U203	94597	Safrole
U204	7783008	Selenious acid
U204	7783008	Selenium dioxide
U205	7488564	Selenium sulfide (R,T)
U015	115026	L-Serine, diazoacetate (ester)
F027*	93721	Silvex (2,4,5-TP)



U206	18883664	Streptozotocin
U103	77781	Sulfuric acid, dimethyl ester
U189	1314803	Sulfur phosphide (R)
F027*	93765	2,4,5-T
U207	95943	1,2,4,5-Tetrachlorobenzene
U208	630206	1,1,1,2-Tetrachloroethane
U209	79345	1,1,2,2-Tetrochloroethane
U210	127184	Tetrachloroethylene
F027*	58902	2,3,4,6-Tetrachlorophenol
U213	109999	Tetrahydrofuran (I)
U214	563688	Thalium(I) acetate
U215	6533739	Thallium(I) carbonate
U216	7791120	Thallium(I) chliride
U216	7791120	Thallium chlirode TlCl
U217	10102451	Thallium(I) nitrate
U218	62555	Thioacetamide
U153	74931	Thiomethanol (I,T)
U244	137368	Thioperoxydicarbonic diamide tetramethyl-
U219	62566	Thiourea
U244	137268	Thiram
U220	108883	Toluene
U221	25376458	Toluenediamine
U223	26471625	Toluene diisocyanate (I)
U328	95534	o-Toluidine
U353	106490	p-Toluidine
U222	636215	o-Toluidine hydrochloride
U011	61825	1H-1,2,4-Triazol-3-amine
U227	79005	1,1,2-Trichloroethane
U228	79016	Trichloroethylene
U121	75694	trichloromonofluoromethane
F027*	95954	2,4,5-Trichlorophenol
F027*	88062	2,4,6-Trichlorophenol

U234	99354	1,3,5-Trinitrobenzene (R,T)
U182	123637	1,3,5-Trioxane,2,4,6-trimethyl-
U235	126727	Tris(2,3-dibromopropyl) phosphate
U236	72571	Trypan blue
U237	66751	Uracil mustard
U176	759739	Urea, N-ethyl-N-nitroso-
U177	684935	Urea, N-methyl-N-nitroso-
U043	75014	Vinyl chloride
U248	81812	Wafarin, & salts conc. 0.03% or less
U239	1330207	Xylene (I)
U200	50555	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenxlyl)-, methyl ester, (3 $\beta$ ,16 $\beta$ ,17 $\alpha$ ,18 $\beta$ ,20 $\alpha$ )-
U249	1314847	Zinc phosphide con. 10% or less

T (Toxicity) R (Reactivity) I (Ignitability) & C (Corrosivity)

Absence of a letter indicates that the compound os only listed for toxicity.

**APPENDIX B. EPA Listed Acute Hazardous Wastes (1993)**

*ABI Note. See <http://www.epa.gov/osw/hazard/wastetypes/pdfs/listing-ref.pdf> (Oct 14, 2014)*

Haz Waste #	CAS #	Substance
P023	107200	Acetaldehyde, chloro-
P002	591082	Acetamide, N-(aminothioxomethyl)-
P057	640197	Acetamide, 2-fluoro-
P058	62748	Acetic acid, fluoro-, sodium salt
P002	591082	1-Acetyl-2-thiourea
P003	107028	Acrolein
P070	116063	Aldicarb
P004	309002	Aldrin
P005	107186	Allyl alcohol
P006	20859728	Aluminum phosphide (R,T)
P007	2763964	5-(Aminomethyl)-3-isoxazolol
P008	504245	4-Aminopyridine
P009	131748	Ammonium picrate (R)
P119	7803556	Ammonium vandate
P099	506616	Argentate(1-),bis(cyano-C-), potassium
P010	7778394	Arsenic acid H <sub>3</sub> AsO <sub>4</sub>
P012	1327533	Arsenic oxide As <sub>2</sub> O <sub>3</sub>
P011	1303282	Arsenic oxide As <sub>2</sub> O <sub>5</sub>
P011	13003282	Arsenic pentoxide
P012	1327533	Arsenic trioxide
P038	692422	Arsine, diethyl-
P036	696286	Arsenous dichloride, phenyl-
P054	151564	Arziridine
P067	75558	Arziridine, 2-methyl-
P013	542621	Barium cyanide
P024	106478	Benzenamine, 4-chloro-
P077	100016	Benzenamine, 4-nitro-
P028	100447	Benzene, (chloromethyl)-

P024	51434	1,2-Benzenediol, 4-[1-hydroxy-2-methylamino)ethyl]-, (R)-
P046	122098	Benzeneethanamine, <b>alpha,alpha</b> -dimethyl-
P014	108985	Benzenethiol
P001	81812	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxy-1 phenylbutyl)-, & salts conc. > 0.3%
P028	100447	Benzyl chloride
P015	7440417	Beryllium
P017	598312	Bromoacetone
P018	357573	Brucine
P045	39196184	2-Butanone, 3,3-dimethyl-1-(methylthio)-,O- [methylamino)carbonyl] oxime
P021	592018	Calcium cyanide Ca(CN) <sub>2</sub>
P022	75150	Carbon disulfide
P095	75445	Carbonic dichloride
P023	107200	Chloroacetaldehyde
P024	106478	p-Chloroaniline
P026	5344821	1-(o-Chlorophenyl)thiourea
P027	542767	3-Chloropropinitrile
P029	544923	Copper cyanide Cu(CN)
P030		Cyanides (soluble cyanide salts), not otherwise specified
P031	460195	Cyanogen
P033	506774	Cyanogen chloride (CN)Cl
P034	131895	2-Cyclohexyl-4,6-dinitrophenol
P016	542881	Dichloromethyl ether
P036	696286	Dichlorophenylarsine
P037	60571	Dieldrin
P038	692422	Diethylarsine
P041	311455	Diethyl-p-nitrophenyl phosphate
P040	297972	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55914	Diisopropylfluorophosphate (DFP)
P004	309002	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a,-hexahydro-, ( <b>1alpha,4alpha,4aβ,5alpha,8alpha,8aβ</b> )-
P060	465736	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a-heaxhydro-, ( <b>1alpha,4alpha,4aβ,5β,8β,8aβ</b> )-
P037	60571	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-

		octahydro-, (1 $\alpha$ ,2 $\beta$ ,2 $\alpha$ ,3 $\beta$ ,6 $\beta$ ,6 $\alpha$ ,7 $\beta$ ,7 $\alpha$ )-
P051	72208	2,7:3,6-Dimethanonaphth [3,2-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1 $\alpha$ ,2 $\beta$ ,2 $\alpha$ ,3 $\alpha$ ,6 $\alpha$ ,6 $\beta$ ,7 $\beta$ ,7 $\alpha$ )- & metabolites
P044	60515	Dimethoate
P046	122098	$\alpha$ , $\alpha$ -Dimethylphenethylamine
P047	534521	4,6-Dinitro-o-cresol, & salts
P048	51285	2,4-Dinitrophenol
P020	88857	Dinoseb
P085	152169	Diphosphoramidate, octamethyl-
P111	107493	Diphosphoric acid, tetraethyl ester
P039	298044	Disulfoton
P049	541537	Dithiobiuret
P050	115297	Endosulfan
P088	145733	Endothall
P051	72208	Endrin, & metabolites
P042	51434	Epinephrine
P031	460195	Ethanedinitrile
P066	16752775	Ethanimidothioic acid,...N-[[methylamino carbonyl]oxy]-, methyl ester
P101	107120	Ethyl cyanide
P054	151564	Ethyleneimine
P097	52827	Famphur
P056	7782414	Fluorine
P057	640197	Fluoroacetamide
P058	62748	Fluoroacetic acid, sodium salt
P065	628864	Fulminic acid, mercury(2+) salt (R,T)
P059	76448	Heptachlor
P062	757584	Hexaethyl tetraphosphate
P116	79196	Hydrazinecarbothioamide
P068	60344	Hydrazine, methyl
P065	74908	Hydrocyanic acid
P063	74908	Hydrogen cyanide
P096	7803512	Hydrogen phosphide
P060	465736	Isodrin

P007	2763964	3(2H)-Isoxazolone, 5-(aminomethyl)-
P092	62384	Mercury, (aceto-O)phenyl-
P065	628864	Mercury fulminate (R,T)
P082	62759	Methanamine, N-methyl-N-nitroso-
P064	624839	Methane, isocyanato-
P016	542881	Methane, oxybis[chloro-
P112	509148	Methane, tetranitro- (R)
P118	75707	Methanethiol, trichloro-
P050	115297	6,9-Methano-2,4,3-benzodioxathiepin,6,7,8,9,10, 10-...hexachloro-1,5,5a,6,9,9a-hexahydro-,3-oxide
P059	76448	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-hepta chloro-...3a,4,7,7a-tetrahydro-
P066	16752775	Methomyl
P068	60344	Methyl hydrazine
P064	624839	Methyl isocyanate
P069	75865	2-Methylacetonitrile
P071	298000	Methyl parathion
P072	86884	<b>alpha</b> -Naphthylthiourea
P073	13463393	Nickel carbonyl Ni(CO) <sub>4</sub> , (T-4)-
P074	557197	Nickel cyanide Ni(CN) <sub>2</sub>
P075	54115	Nicotine, & salts
P076	10102439	Nitric oxide
P077	100013	p-Nitroaniline
P078	10102440	Nitrogen dioxide
P076	10102439	Nitrogen oxide NO
P078	10102440	Nitrogen oxide NO <sub>2</sub>
P081	55630	Nitroglycerine (R)
P082	62759	N-Nitrosodimethylamine
P084	4549400	N-Nitrosomethylvinylamine
P085	152169	Octamethylpyrophosphoramidate
P087	20816120	Osmium oxide OsO <sub>4</sub> , (T-4)-
P087	20816120	Osmium tetroxide
P088	145733	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid

P089	56382	Parathion
P034	131895	Phenol,2-cyclohexyl-4,6-dinitro-
P048	51285	Phenol, 2,4-dinitro-
P047	534521	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88857	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131748	Phenolm 2,4,6-trinitro-, ammonium salt (R)
P092	62384	Phenylmercury acetate
P093	103855	Phenylthiourea
P094	298022	Phorate
P095	75445	Phosgene
P096	7803512	Phosphine
P041	311455	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	298044	Phosphorodithioic acid, O,O-diethyl...S- [2-(ethylthio)ethyl] ester
P094	298022	Phosphorodithioic acid, O,O-diethyl...S- [(ethylthio)methyl] ester
P044	60515	Phosphorodithioic acid, O,O-dimethyl...S- [2-(methylamino)-2-oxoethyl] ester
P043	55914	Phosphorofluoridic acid, bis(1-methylethyl) ester
P089	56382	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	297972	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52857	Phosphorothioic acid,...O-[4-[(dimethylamino) sulfonyl]phenyl] O,O-dimethyl ester
P071	298000	Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester
P110	78002	Plumbane. tetraethyl-
P098	151508	Potassium cyanide K(CN)
P099	506616	Potassium silver cyanide
P070	116063	Propanal, 2-methyl-2-(methylthio)-,...O-[(methylamino)carbonyl]oxime
P101	107120	Propanenitrile
P027	542767	Propanenitrile, 3-chloro-
P069	75865	Propanenitrile, 2-hydroxy-2-methyl-
P081	55630	1,2,3-Propanetriol, trinitrate (R)
P017	598312	2-Propanone, 1-bromo-
P102	107197	Propargyl alcohol
P003	107028	2-Propenal
P005	107186	2-Propen-1-ol

P067	7558	1,2-Propylenimine
P102	107197	2-Propyn-1-ol
P008	504245	4-Pyridinamine
P075	54115	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S) & salts
P114	12039520	Selenious acid, dithallium(1+) salt
P103	630104	Selenourea
P104	506649	Silver cyanide Ag(CN)
P105	26628228	Sodium azide
P106	143339	Sodium cyanide Na(CN)
P108	57249	Strychnidin-10-one, & salts
P018	357573	Strychnidin-10-one, 2,3-dimethoxy-
P108	57249	Strychnine, & salts
P115	7446186	Sulfuric acid, dithallium(1+) salt
P109	3689245	Tetraethyldithiopyrophosphate
P110	78002	Tetraethyl lead
P111	107493	Tetraethyl pyrophosphate
P112	509148	Tetranitromethane (R)
P062	757584	Tetraphosphoric acid, hexaethyl ester
P113	1314325	Thallic oxide
P113	1314325	Thallium oxide $Tl_2O_3$
P114	12039520	Thallium (I) selenite
P115	7446186	Thallium (I) sulfate
P109	3689245	Thiophosphoric acid, tetraethyl ester
P045	39196184	Thiofanox
P049	541537	Thioimidodicarbonic diamide $[(H_2N)C(S)]_2NH$
P014	108985	Thiophenol
P116	79196	Thiosemicarbazide
P026	5344821	Thiourea, (2-chlorophenyl)-
P072	86884	Thiourea, 1-naphthalenyl-
P093	103855	Thiourea, phenyl-
P123	8001352	Toxaphene
P118	75707	Trichloromethanethiol



P119	7803556	Vanadic acid, ammonium salt
P120	1314621	Vandium oxide $V_2O_5$
P120	1314621	Vandium pentoxide
P084	4549400	Vinylamine, N-methyl-N-nitroso-
P001	81812	Wafarin, & salts conc. >0.3%
P121	557211	Zinc cyanide $Zn(CN)_2$
P122	1314847	Zinc phosphide $Zn_3P_2$ conc. >10% (R,T)

T (Toxicity) R (Reactivity) I (Ignitability) & C (Corrosivity)

Absence of a letter indicates that the compound is only listed for toxicity.

APPENDIX C.

<b>Chemicals ok to flush down the drain:</b>		
<b>Cation</b>	<b>Cation</b>	<b>Anion</b>
Aluminum	Palladium	Bisulfite
Bismuth	Potassium	Bromate
Calcium	Rubidium	Bromide
Cerium	Scandium	Carbonate
Cesium	Strontium	Chloride
Copper	Tantalum	Cyanate
Gold	Tin	Hydroxide
Iron	Titanium	Iodide
Lanthides	Yttrium	Oxide
Lithium	Zinc	Phosphate
Magnesium	Zirconium	Sulfate
Molybdiium (VI)		Sulfite
Niobium (V)		Thiocyanate

## APPENDIX D.

<b>High-Energy Oxidizers:</b>
Barium peroxide ( $\text{BaO}_2$ ): combined with organic substances sensitive to friction, severe damage to respiratory sys.
Bromine (Br): highly reactive, serious tissue burns, toxic, serious damage to respiratory sys.
Calcium hypochlorite ( $\text{Ca}[\text{ClO}]_2$ ): combined with flammables or organics easily ignited. $\text{Cl}_2$ evolved mixed with acids.
Chromium anhydride/Chromic acid ( $\text{CrO}_3$ ): Ignites with acetic acid or alcohol. May ignite with other organics.
Hydrogen peroxide ( $\text{H}_2\text{O}_2$ ): 35-50% ignites with organics, higher concentrations yield shock sensitive peroxides. Violently decomposes in contact with metals and salts, i.e. brass, bronze, Cr, Cu, Fe, Pb, Mn, Ag, etc.
Magnesium perchlorate ( $\text{Mg}[\text{ClO}_4]_2$ ): Sensitive by heat or friction.
Nitric acid ( $\text{HNO}_3$ ): explosive with carbides, $\text{H}_2\text{S}$ , metallic powders, & turpentine. Severe burns to tissue.
Perchloric acid ( $\text{HClO}_4$ ): very dangerous at high concentrations and temperatures.
Potassium bromate ( $\text{KBrO}_3$ ): Moderate health haz. Ignites by heat or friction.
Potassium chlorate ( $\text{KClO}_3$ ): Toxic and toxic fumes upon combustion. Ignites by heat or friction.
Potassium perchlorate ( $\text{KClO}_4$ ): similar to Potassium chlorate.
Sodium perchlorate ( $\text{NaClO}_4$ ): similar to Potassium perchlorate.
Sodium peroxide ( $\text{Na}_2\text{O}_2$ ): reacts vigorously with water. Mixtures with, combustible, organic, or easily oxidizable materials are explosive. They ignite easily with heat, friction, or small quantities of water. Toxic if ingested.

## APPENDIX E.

### COMPATIBILITY OF CHEMICALS ACCORDING TO HAZARD CLASS

The following outline can be used to segregate laboratory chemicals. Chemical groups should be kept separate from each other.

- Group A      Inorganic Acids and Related Compounds  
Examples: Hydrochloric, Sulfuric, Nitric acids (>40%) etc.  
Hazard: Corrosive
- Group B      Alkalis, Bases, Amines  
Examples: Caustic Soda, Potassium Hydroxide, Sodium Hydroxide, Ethanolamine, etc.  
Hazard: Corrosive
- Group C      Elements and Inorganic Salts, Carcinogens, Pesticides  
Examples: Mercury, Lead, Aluminum Sulfate, Sodium Thiosulfate, Benzidine, Aldrin, Chlordane, etc.  
Hazard: Poison
- Group D      Organic Solvents, Aldehydes, Esters, Ketones, Hydrocarbons  
Examples: Methanol, Acetaldehyde, Ethyl Ether, Acetone, Hexane, etc.  
Hazard: Flammable or Combustible Liquids
- Group E      Reactive Materials  
Examples: Aluminum Hydroxide, Sodium Metal, Phosphorous Pentoxide, Potassium Metal, etc.  
Hazard: Flammable Solid, Corrosive
- Group F      Organic Acids, Substituted Acids  
Examples: Acetic Acid, Butyric Acid, Formic Acid, etc.  
Hazard: Corrosive
- Group G      Oxidizers  
Examples: Ammonium Nitrate, Potassium Permanganate, Sodium Nitrate, Barium Chlorate, etc.  
Hazard: Oxidizer
- Group H      Peroxides  
Examples: Benzyl Peroxide, Urea Peroxide, Peracetic Acid, Cumene Hydroperoxide, etc.
- Group I      Cyanides, Sulfides (Keep away from acids)  
Examples: Potassium Cyanide, Potassium Sulfide, Hydrocyanic Acid, Allyl Cyanide, etc.  
Hazard: Poison

Appendix F.

Segregation of Chemicals for Storage

SOLIDS	LIQUIDS	GASES
A. Oxidizers	A. Flammable	A. Toxic
B. Flammable	B. Others	B. Flammable
C. Water Reactive	1. Acids	C. Oxidizers & Others
D. All Others *	2. Caustics	
	3. Perchloric Acid	
	4. Oxidizers	

\*Use Compatibility charts for segregation of others.

## GLOSSARY

**ACGIH** The American Conference of Governmental Industrial Hygienists is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

**ACUTE** Severe, often dangerous conditions in which relatively rapid changes occur.

**ACUTE EXPOSURE** An intense exposure over a relatively short period of time.

**ANSI** The American National Standards Institute is a voluntary membership organization (run with private funding) that develops consensus standards nationally for a wide variety of devices and procedures.

**ASPHYXIAN** A Chemical (gas or vapor) that can cause death or unconsciousness by suffocation. Simple asphyxiants such as nitrogen, either use up or displace oxygen in the air. They become especially dangerous in confined or enclosed spaces. Chemical asphyxiants, such as carbon monoxide and hydrogen sulfide, interfere with the body's ability to absorb or transport oxygen to the tissues.

**BOILING POINT** The temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which the liquid changes to a vapor. The boiling point is usually expressed in degrees Fahrenheit. If a flammable material has a low boiling point, it indicates a special fire hazard.

**"C" or CEILING** A description usually seen in connection with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value--Ceiling. (See also THRESHOLD LIMIT VALUE.)

**CARCINOGEN** A substance or physical agent that may cause cancer in animals or humans.

**CAS NUMBER** Identifies a particular chemical by the Chemical Abstracts Service, a service of the American Chemical Society that indexes and compiles abstracts of worldwide chemical literature called "Chemical Abstracts."

**CC** Cubic centimeter, a volumetric measurement which is also equal to one milliliter (ml).

**CHEMICAL** As broadly applied to the chemical industry, an element or a compound produced by chemical reactions on a large scale for either direct industrial and consumer use or for reaction with other chemicals.

**CHEMICAL REACTION** A change in the arrangement of atoms or molecules to yield substances of different composition and properties. (See REACTIVITY.)

**CHRONIC** Persistent, prolonged or repeated conditions.

**CHRONIC EXPOSURE** A prolonged exposure occurring over a period of days, weeks, or years.

**COMBUSTIBLE** According to the DOT and NFPA, combustible liquids are those having a flash point at or above 100°F (37.8 C), or liquids that will burn. They do not ignite as easily as flammable liquids. However, combustible liquids can be ignited under certain circumstances, and must be handled with caution. Substances such as wood, paper, etc., are termed "Ordinary Combustibles."

**CONCENTRATION** The relative amount of a material in combination with another material. For example, 5 parts (of acetone) per million (parts of air).

**CORROSIVE** A substance that, according to the DOT, causes visible destruction or permanent changes in human skin tissue at the site of contact or is highly corrosive to steel.

**CUBIC METER (m<sup>3</sup>)** A measure of volume in the metric system.

CUTANEOUS Pertaining to or affecting the skin.

DECOMPOSITION The breakdown of a chemical or substance into different parts or simpler compounds. Decomposition can occur due to heat, chemical reaction, decay, etc.

DERMAL Pertaining to or affecting the skin.

DERMATITIS An inflammation of the skin.

DILUTION VENTILATION See General Ventilation

DOT The United States Department of Transportation is the federal agency that regulates the labeling and transportation of hazardous materials.

DYSPNEA Shortness of breath; difficult or labored breathing.

EPA The Environmental Protection Agency is the governmental agency responsible for administration of laws to control and/or reduce pollution of air, water, and land systems.

EPA NUMBER The number assigned to chemicals regulated by the Environmental Protection Agency (EPA).

EPIDEMIOLOGY The study of disease in human populations.

ERYTHEMA A reddening of the skin.

EVAPORATION RATE The rate at which a material is converted to vapor (evaporates) at a given temperature and pressure when compared to the evaporation rate of a given substance. Health and fire hazard evaluations of materials involve consideration of evaporation rates as one aspect of the valuation.

°F Degrees Fahrenheit; a temperature scale.

FLAMMABLE LIQUID According to the DOT and NFPA a flammable liquid is one that has a flash point below 100°F. (See FLASH POINT.)

FLASH POINT The lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture and burn when a source of ignition (sparks, open flames, cigarettes, etc.) is present. Two tests are used to determine the flash point: open cup and closed cup. The test method is indicated on the MSDS after the flash point.

g See GRAM

GENERAL VENTILATION Also known as general exhaust ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. This is not the recommended type of ventilation to control contaminants that are highly toxic, when there may be corrosion problems from the contaminant, when the worker is close to where the contaminant is being generated, and where fire or explosion hazards are generated close to sources of ignition (See Local Exhaust Ventilation).

g/Kg See Grams Per Kilogram

GRAM (g) A metric unit of weight. One ounce equals 28.4 grams.

GRAMS PER KILOGRAM (g/Kg) This indicates the dose of a substance given to test animals in toxicity studies. For example, a dose may be 2 grams (of substance) per kilogram of body weight (of the experimental animal).

HAZARDOUS MATERIAL Any substance or compound that has the capability of producing adverse effects on the health and safety of humans.

IGNITABLE A solid, liquid or compressed gas waste that has a flash point of less than 140 °F. Ignitable material may be

regulated by the EPA as a hazardous waste, as well.

**INCOMPATIBLE** The term applied to two substances to indicate that one material cannot be mixed with the other without the possibility of a dangerous reaction.

**INGESTION** Taking a substance into the body through the mouth as food, drink, medicine, or unknowingly as on contaminated hands or cigarettes, etc.

**INHALATION** The breathing in of an airborne substance that may be in the form of gases, fumes mists, vapors, dusts, or aerosols.

**INHIBITOR** A substance that is added to another to prevent or slow down an unwanted reaction or change.

**IRRITANT** A substance that produces an irritating effect when it contacts skin, eyes, nose, or respiratory system.

**Kg** See Kilogram

**KILOGRAM (Kg)** A unit of weight in the metric system equal to 2.2 pounds.

**L** See Liter

**LC** See Lethal Concentration

**LD** See Lethal Dose

**LEL** See Lower explosive limit

**LETHAL CONCENTRATION<sub>50</sub> (LC<sub>50</sub>)** The concentration of an air contaminant that will kill 50 percent of the test animals in a group during a single exposure.

**LETHAL DOSE<sub>50</sub> (LD<sub>50</sub>)** The dose of a substance or chemical that will kill 50 percent of the test animals in a group within the first 30 days following exposure.

**LFL** See Lower Explosive Limit

**LITER (L)** A measure of capacity. One quart equals .9 liter.

**LOCAL EXHAUST VENTILATION** (Also known as exhaust ventilation.)

A ventilation system that captures and removes the contaminants at the point they are being produced before they escape into the workroom air. The system consists of hoods, ductwork, a fan and possibly an air cleaning device. Advantages of local exhaust ventilation over general ventilation include: It removes the contaminant rather than dilutes it; it requires less airflow and thus is more economical over the long term; and the system can be used to conserve or reclaim valuable materials. However, the system must be properly designed with the correctly shaped and placed hoods, and correctly sized fans and ductwork.

**LOWER EXPLOSIVE LIMIT (LEL)** [Also known as Lower Flammable Limit (LFL)] The lowest concentration of a substance that will produce a fire or flash when an ignition source (flame, spark, etc.) is present. It is expressed in percent of vapor or gas in the air by volume. Below the LEL or LFL, the air/contaminant mixture is theoretically too "lean" to burn. (See also UEL)

**m<sup>3</sup>** See Cubic Meter

**MELTING POINT** The temperature at which a solid changes to a liquid. A melting range may be given for mixtures.

**mg** See Milligram

**Mg/Kg** See Milligrams Per Kilogram



mg/m<sup>3</sup> See Milligrams Per Cubic Meter

MILLIGRAM (mg) A unit of weight in the metric system. One thousand milligrams equal one gram.

MILLIGRAMS PER CUBIC METER (mg/m<sup>3</sup>) Units used to measure air concentrations of dust, gases, mists, and fumes.

MILLIGRAMS PER KILOGRAM (mg/kg) This indicates the dose of a substance given to test animals in toxicity studies. For example, a dose may be 2 milligrams (of substance) per kilogram of body weight (of the experimental animal).

MILLILITER (ml) A metric unit used to measure capacity. One milliliter equals one cubic centimeter. One thousand milliliters equal one liter.

ml See MILLILITER

MSHA The Mine Safety and Health Administration; a federal agency that regulates the mining industry in the safety and health area.

MUTAGEN Anything that can cause a change (or mutation) in the genetic material of a living cell.

NARCOSIS Stupor or unconsciousness caused by exposure to a chemical.

NFPA The National Fire Protection Association is a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 704, "Identification of the Fire Hazards of Materials." This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-known diamond system using from zero through four to indicate severity of the hazard. Zero indicates no special hazard and four indicates severe hazard.

NIOSH The National Institute for Occupational Safety and Health is a federal agency that among its various responsibilities trains occupational health and safety professionals, conducts research on health and safety concerns, and tests and certifies respirators for workplace use.

ODOR THRESHOLD The minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor.

ORAL Having to do with the mouth.

OSHA The Occupational Safety and Health Administration--a federal agency under the Department of Labor that publishes and enforces safety and health regulations for most businesses and industries in the United States.

OXIDATION The process of combining oxygen with some other substance or a chemical change in which an atom loses electrons.

OXIDIZER Is a substance that gives up oxygen easily to stimulate combustion of organic material.

OXYGEN DEFICIENCY An atmosphere having less than the normal percentage of oxygen found in normal air. Normal air contains 21% oxygen at sea level.

PEL See PERMISSIBLE EXPOSURE LIMIT

PERMISSIBLE EXPOSURE LIMIT (PEL) An exposure limit that is published and enforced by OSHA as a legal standard. PEL may be either a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling (C). The PELs are found in Tables Z-1, Z-2, or Z-3 of OSHA regulations 1910.1000. (See also TLV)

PERSONAL PROTECTIVE EQUIPMENT Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.

**POLYMERIZATION** A chemical reaction in which two or more small molecules combine to form larger molecules that contain repeating structural units of the original molecules. A hazardous polymerization is the above reaction with an uncontrolled release of energy.

**ppm** Parts of substance per million parts of air (by volume)  
or parts of substance per million parts of liquid.

**REACTIVITY** A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosion, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, and dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on a MSDS.

**RESPIRATOR** A device which is designed to protect the wearer from inhaling harmful contaminants.

**RESPIRATORY HAZARD** A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system or by being breathed into the lungs, results in some bodily function impairment.

**SENSITIZER** A substance that may cause no reaction in a person during initial exposures, but afterwards, further exposures will cause an allergic response to the substance.

**SHORT TERM EXPOSURE LIMIT** Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures. Also the daily TLV-TWA must be exceeded.

**SKIN** This designation sometimes appears alongside a TLV or PEL. It refers to the possibility of absorption of the particular chemical through the skin and eyes. Thus, protection of large surface areas of skin should be considered to prevent skin absorption so that the TLV is not invalidated.

**STEL** Short term exposure limit.

**SUBSTANCE** Any chemical entity.

**SYNONYM** Another name by which the same chemical may be known.

**SYSTEMIC** Spread throughout the body; affecting many or all body systems or organs; not localized in one spot or area.

**TERATOGEN** An agent or substance that may cause physical defects in the developing embryo or fetus when a pregnant female is exposed to that substance.

**THRESHOLD LIMIT VALUE** Airborne concentrations of substances devised by the ACGIH that represents conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLV's: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL) and Ceiling (TLV-C). (See also PEL)

**TIME WEIGHTED AVERAGE** The average time, over a given work period (e.g. 8-hour workday), of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period. Represented as TLV-TWA.

**TLV** See THRESHOLD LIMIT VALUE

**TOXICITY** The potential of a substance to exert a harmful effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place.

**TRADE NAME** The commercial name or trademark by which a chemical is known. One chemical may have a variety of trade names depending on the manufacturers or distributors involved.

TWA See TIME WEIGHTED AVERAGE

UEL See UPPER EXPLOSIVE LIMIT

UFL See UPPER EXPLOSIVE LIMIT

UNSTABLE LIQUID A liquid that, in its pure state or as commercially produced, will react vigorously in some hazardous way under shock conditions (i.e., dropping), certain temperatures, or pressures.

UPPER EXPLOSIVE LIMIT Also known as Upper Flammable Limit. Is the highest concentration (expressed in percent of vapor or gas in the air by volume) of a substance that will burn or explode when an ignition source is present. Theoretically above this limit the mixture is said to be "rich" to support combustion. The difference between the LEL and the UEL constitutes the flammable range or explosive range of a substance. That is, if the LEL is 1 ppm and the UEL is 5 ppm, then the explosive range of the chemical is 1 ppm to 5 ppm. (See also LEL)

VAPOR The gaseous form of substances which are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids such as solvents. Solvents with low boiling points will evaporate.

## REFERENCES

1. Altman, P. L., Dittmer, D. S. Biology Data Book, Vol. I-III, 2nd ed., Fed. of Am. Societies for Experimental Biology: Bethesda, MD., 1972.
2. Anon. Toxic and Hazardous Industrial Chemicals Safety Manual, International Technical Information Institute: Tokyo, Japan, 1979.
3. Bretherick, L. Handbook of Reactive Chemical Hazards, 2nd ed., Butterworths: Boston, MA., 1979.
4. Brodsky, A., editor, CRC Handbook of Radiation Measurement and Protection, CRC Press Inc: West Palm Beach, FL., 1978.
5. Carcinogens, U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program, U.S. Government Printing Office, Washington, D.C., latest edition.
6. Casarett, A. Radiation Biology, Prentice-Hall, Inc. Englewood Cliffs, NJ., 1968.
7. Casarett, L. J., Doull, J., Eds., Toxicology, Macmillan: New York, 1975.
8. Cember, H. Introduction to Health Physics, Pergamon Press: New York, 1969.
9. Deichmann, W. B., Gerarde, H. W. Toxicology of Drugs and Chemicals, 4th ed., Academic Press: New York, 1969.
10. Delaware Code, Title 16, Chapter 24, "Hazardous Chemical Information Act", State of Delaware: Dover, Delaware.
11. Documentation of the Threshold Limit Values for Substances in the Workroom Air and Supplemental Documentation, American Conference of Governmental Industrial Hygienist: Cincinnati, OH., (latest edition).
12. Fire Protection Guide on Hazardous Materials, 7th ed., National Fire Protection Association: Boston, MA.
13. Goodman, L.S., Gilman, A., The Pharmacological Basis of Therapeutics, Macmillan: NY, 1975.
14. Gosselin, R. E., et al., Clinical Toxicology of Commercial Products: Acute Poisoning, 4th ed., Williams and Wilkins: Baltimore, 1976.
15. Green, M. E., Turk, A., Safety in Working with Chemicals, McMillan: New York, NY., 1978.
16. The Hazard Communication Standard - A Guide Book, National Safety Council: Chicago, IL., 60611.
17. Hilado, C. J., Clark, S. W., Autoignition Temperatures of Organic Solvents, Chem. Eng.: (NY), 1972, 79 (19), 75-80.
18. The Industrial Environment-Its Evaluation and Control, U.S. Department of Health, Education and Welfare, Public Health Service, NIOSH, U.S. Printing Office: Washington, DC., Stock Number 017-001-00296-4, 1973.
19. Industrial Ventilation, American Conference of Governmental Industrial Hygienists, Committee on Industrial Ventilation: Lansing, MI., (latest edition).
20. Knoll, G., Radiation Detection and Measurement, John Wiley & Sons, NY, 1979.
21. Lewis, R. J., Ed. Registry of Toxic Effects of Chemical Substances, DHEW (NIOSH), Publ Microfiche issued quarterly.
22. Loomis, T. A. Essentials of Toxicology, 3rd ed., Lea and Febiger: Philadelphia, 1978.
23. Martin, A., Harbison, S. Radiation Protection, Chapman and Hall, Ltd.: London, England, 1979.
24. Moe, Lasuk, Schumacher, and Hunt. Radiation Safety Technician Training Course, Argonne National Laboratory, ANL-7291 Rev. 1, Health and Safety, May 1972, available from NTIS, USDC: Springfield, VA. 22151.
25. Morgan, K., Turner, J. Principles of Radiation Protection, Robert E. Krieger Publishing Co.: Huntington, NY., 1973.
26. Murr, G. D., Ed., Hazards in the Chemical Laboratory, 2nd ed., Chemical Society: London, 1972.
27. NIOSH/OSHA Product Guide to Chemical Hazards, DHEW (NIOSH): Sept. 1978, Publ. No. 78-210.

28. Olishifski, Julian B., NeElroy, Frank E. Fundamentals of Industrial Hygiene, National Safety Council: Chicao, IL., 1976.
29. OSHA Safety and Health Standards (29CFR1910), United States Department of Labor, OSHA, Government Printing Office: Washington, DC., (latest edition).
30. Patty, F. A. Industrial Hygiene and Toxicology: Volume II-Toxicology, Interscience Wiley: New York, 1980.
31. Proctor, N., Hughes, J. Chemical Hazards in the Workplace, Lippincott: Philadelphia, 1978.
32. Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Research Council, National Academy Press: Washington, DC., 1981.
33. Radiological Health Handbook, U.S.H.E.W., Public Health Service, F.D.A., Bureau of Radiological Health: Rockville, MD. 20852, available from U.S.G.P.O. Stock number 017-011-00043-0.
34. Safety in Academic Chemistry Laboratories. 3red ed., Committee on Chemical Safety, American Chemical Society: Washington, D.C., 1979.
35. Sax, N.I. Dangerous Properties of Industrial Materials, 5th ed., Van Nostrand-Reinhold: New York, 1979.
36. Shapiro, J. Radiation Protection, Howard University Press: Cambridge, MA., 1981.
37. Sitting, M. Hazardous and Toxic Effects of Industrial Chemicals, Noyes Data Corp.: Park Ridge, NJ., 1979.
38. Steere, N.V., Ed., CRC Handbook of Laboratory Safety, 2nd ed., CRC Press: West Palm Beach, FL., 1971.
39. TLVs: Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes, TLV Airborne Contaminants Committee, American Conference of Governmental Industrial Hygienists: Cincinnati, OH., (latest edition).
40. Walters, D. C., Ed., Safe Handling of Chemical Carcinogens, Mutagens, Teratogens, and Highly Toxic Substances, Ann Arbor Science Publishers, Inc.: Ann Arbor, MI., 1980, Vol. 1.
41. Winholz, M., Ed., The Merck Index, 9th ed., Merck and Company: Rahway, NJ., 1976.
42. Zabetakis, M. G. Flammable Characteristics of Combustible Gases and Vapors, U.S. Bureau of Mines Bulletin 627, 1965.

---

Page intentionally left blank

---

Page intentionally left blank



**Environmental Health & Safety**

# **Radiation Safety Manual**

---



**July 9, 2012**



**Arkansas State University  
Arkansas Biosciences Institute**

**NOTES**

(October 14<sup>th</sup>, 2014)

---

**Radiation Safety Manual**

---

1. Date this manual was officially last updated: July 9<sup>th</sup>, 2012.
  2. This document was downloaded on October 14<sup>th</sup>, 2014, from:  
[http://www.astate.edu/a/ehs/environmental-compliance/files/Radiation\\_Safety.pdf](http://www.astate.edu/a/ehs/environmental-compliance/files/Radiation_Safety.pdf).  
To facilitate the reading of this manual, pages have been numbered in **red**.
-

# Arkansas State University

## Environmental Health & Safety

### **Radiation Safety**

9 July 2012

#### **INTRODUCTION**

The objectives of the **Arkansas State University Radiation Safety Program** are to assist in fulfilling the [University's](#) commitment to provide a safe and healthy environment for employment and learning and to establish and promote safe practices at all times. Protection of employees, students, the public, and university property and operations are paramount and every attempt will be made to ensure that our facilities are as free as possible from recognized radiation hazards.

The [Arkansas Department of Health](#) has issued a **Specific Broad Scope License** to Arkansas State University. This license authorizes and tightly regulates the responsible use of radionuclides on our campus.

The purpose of Arkansas State University's **Radiation Safety Manual** is to assist faculty, staff, and students in complying with the objects and terms of the Arkansas Department of Health and the ASU Radiation Safety Committee. This manual is not intended to be an exhaustive or fully comprehensive reference, but rather a guide to enable qualified personnel safe and efficient use of radionuclides and ancillary staff protection from undesirable exposure to the effects of radionuclide use. Further information associated with the use of radioactive materials on this campus can be obtained by contacting the [ASU Radiation Safety Officer](#). For a list of college and university environmental health and safety web sites (most of which include their radiation safety unit), check out the [University of Kentucky's Fiscal Affairs](#) site. Notices of recent actions by the Arkansas Department of Health regarding Arkansas State's radiation safety program can be reviewed through the office of Environmental Health & Safety.

Radiation Event Medical Management at the U.S. Department of Health & Human Services  
<http://remm.nlm.gov/>

**FOR**  
**Emergency Assistance**

**In case of an emergency or accident situation:**

Notify:

[Radiation Safety Officer](#) at 972-3082

or

[Environmental Health & Safety](#) at 972-2862

Nights, Weekends or Holidays:

Notify

University Police

972-2093

**AND**

[Radiation Safety Officer](#)

932-3739

or

[Environmental Health & Safety](#)

926-3928

For routine information contact the [Radiation Safety Officer](#)

972-3082

# **Arkansas State University Radiation Safety Manual**

## **TABLE OF CONTENTS**

### **1.0 RADIATION SAFETY COMMITTEE (RSC)**

1.1 The Purpose of the Radiation Safety Committee

1.2 Organization of the Radiation Safety Committee

1.3 Radiation Safety Committee Responsibilities

### **2.0 RADIATION SAFETY OFFICER (RSO)**

2.1 RSO Duties and Responsibilities

### **3.0 UNIVERSITY SAFETY OFFICER (USO)**

3.1 Duties and Responsibilities

### **4.0 LICENSING AND REGISTRATION REGULATIONS**

4.1 Federal Regulations

4.2 State Regulations

4.3 Arkansas State University Campus Regulations

4.4 Posting of Notices

### **5.0 APPROVED USERS**

5.1 Principal User

5.2 Authorized User

5.3 Individual User

5.4 Responsibilities of Users

## **6.0 PROCUREMENT, RECEIPT AND INVENTORY OF RADIOACTIVE MATERIALS**

6.1 Purchases

6.2 Receipt of Radioactive Materials

6.3 Transfer of Possession

6.4 Security and Storage of Radioactive Materials

6.4.1 Security

6.4.2 Storage

## **7.0 RULES FOR THE SAFE HANDLING OF RADIOACTIVE MATERIALS**

7.1 Classification of Areas

7.1.1 Unrestricted Areas

7.1.2 Controlled Areas

7.1.3 Restricted Areas

7.2 Radiation Dose Limits

7.2.1 ALARA

7.2.2 Occupational Dose Limits

7.2.3 Minors Working Radioactive Materials

7.2.4 Exposure Limits for the General Public

7.2.5 Exposure Limits To An Embryo/Fetus

7.3 Personnel Monitoring

7.3.1 Dosimeters

7.3.2 BioAssays

7.4 Posting of Laboratories and Areas

7.5 Posting of Equipment

7.6 Vacating Laboratory Spaces

## **8.0 SURVEYS**

8.1 User Guidelines for Conducting Surveys

8.2 Contamination Levels

8.3 Leak Tests

8.4 Survey Instruments and Calibration

## **9.0 RADIOACTIVE WASTE**

9.1 Decay In Storage

9.2 Disposal of Liquid Wastes

9.3 Disposal of Solid Wastes

9.4 Disposal of Animals/Animal Tissue

## **10.0 EMERGENCY PROCEDURES**

10.1 Accident Procedures

## **11.0 VIOLATIONS, SUSPENSIONS AND APPEALS**

11.1 Violation Guidelines

## **APPENDICES**

**Appendix I** Radiation Safety Committee Members

**Appendix II** Acceptable Training and Experience Requirements for Users

**Appendix III** Inventory and Disposal Log for Radioactive Material

**Appendix IV** Request for Approval to Purchase/Acquire Radioactive Material

**Appendix V** Logbook for Area Surveys and Swipe Test Results

**Appendix VI** Personnel Monitoring

**Appendix VII** Notice to Employees Form X

**Appendix VIII** Material Licensed for Use at ASU

**Appendix IX** Guidelines for Bio-Assays

## **1.0 RADIATION SAFETY COMMITTEE (RSC)**

### **1.1 THE PURPOSE OF THE RADIATION SAFETY COMMITTEE**

Arkansas Department of Health, Division of Radiation Control and Emergency Management regulations require the establishment of a Radiation Safety Committee (RSC). The purpose of the RSC is to promote the best practice in safe handling and use of radiation sources. The RSC is also established to assure compliance with State regulations and the conditions set forth by the license. Any individual or action, which jeopardizes the license, endangers the permission of all researchers to utilize radioactive materials at Arkansas State University.

### **1.2 ORGANIZATION OF THE RADIATION SAFETY COMMITTEE**

The Radiation Safety Committee, which meets at least annually and as necessary to conduct the business of the radiation safety program, is comprised of the Radiation Safety Officer, Committee Chair (an appropriate representative appointed by the Office of Research and Academic Affairs), University Safety Officer, one (1) licensed user, one (1) physicist with knowledge of radiation physics and two (2) faculty members, one of which must be from outside ABI, Agriculture, and the College of Science and Mathematics, trained and experienced in the safe use of radioactive materials.

### **1.3 RADIATION SAFETY COMMITTEE RESPONSIBILITIES**

This Committee is responsible for establishing procedures and policies for the authorized procurement, protection, use, and disposal of radioactive materials and for the safety and protection of all personnel, students and visitors, on the Arkansas State University Campus. The Committee shall:

1. Provide technical and administrative guidance and aid in the interpretation of various regulations governing the use of radioactive materials.
2. Review and act upon all new, renewal, and amended applications for possession and use of radioactive materials.
3. Determine the adequacy of training and experience of persons requesting permission to use or supervise the use of radioactive materials.
4. Determine the suitability of space, facilities, or equipment designated for use or storage of radioactive materials.



5. Receive and review periodic reports from the RSO on monitoring, contamination, and personnel exposure.

6. Meet, at the call of the chair of the Radiation Safety Committee or designated representative, to review alleged infractions of safety rules and regulations, incidents, and emergencies concerning any radiation program or project.

## **2.0 RADIATION SAFETY OFFICER (RSO)**

### **2.1 RSO DUTIES AND RESPONSIBILITIES**

The Radiation Safety Officer derives authority from the Office of Research and Academic Affairs. The RSO's duties and responsibilities include ensuring radiological safety and compliance with Arkansas Health Department Division of Radiation Control and Emergency Management and Department Of Transportation regulations and the conditions of the University license. The RSO's duties and responsibilities include the following:

1. Ensure that the radioactive material possessed by Arkansas State University is limited to the types and quantities of material listed on the license.
2. Oversee all activities involving radioactive material, including monitoring and surveys of all areas in which radioactive material is used and stored.
3. Provide necessary information on all aspects of radiation protection to personnel at all levels of responsibility
4. Oversee proper delivery, receipt, and radiation surveys of all shipments of radioactive material arriving at the University, as well as proper packaging and labeling of all radioactive material being shipped from the University.
5. Distribute and process personnel radiation monitoring equipment, determine the need for and evaluate bioassays, monitor personnel radiation exposure and bioassay records for trends and high exposures, notify individuals and their supervisors of radiation exposures approaching the limits, and recommend appropriate remedial action.
6. Coordinate or conduct training programs and otherwise instruct personnel in the proper procedures for handling radioactive material prior to use, at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.
7. Supervise and coordinate the radioactive waste disposal program, including effluent monitoring and recordkeeping on waste storage and disposal records.
8. Oversee the storage of radioactive material not in current use, including waste.

9. Perform or arrange for leak tests on all sealed sources and for calibration of radiation survey instruments.
10. Immediately terminate any unsafe condition or activity that is found to be a threat to public health and safety or property.
11. Maintain other records not specifically designated above, including records of receipts, transfers, and surveys as required by Arkansas State Board of Health (ASBH) Rules and Regulations.
12. Attend periodic meetings of the Radiation Safety Committee and provide reports to the Committee and Vice Chancellor for Research and Academic Affairs.
13. Ensure that the results of audits, identification of deficiencies, and recommendations for change are documented (and maintained for at least 3 years) and provided to the Radiation Safety Committee and the Vice Chancellor for Research and Academic Affairs for review; ensure that prompt action is taken to correct deficiencies.
14. Ensure that the audit results and corrective actions are made available to all personnel who use licensed material.
15. Ensure that all incidents, accidents, and personnel exposure to radiation as defined by the ASBH Rules and Regulations are investigated and reported to the Arkansas Department of Health and other appropriate authorities, if required, within the required time limits.
16. Maintain understanding of and up-to-date copies of regulations, the license and revised license procedures, and ensure that the license is amended whenever there are changes in licensed activities or responsible individuals.

### **3.0 UNIVERSITY SAFETY OFFICER (USO)**

#### **3.1 DUTIES AND RESPONSIBILITIES**

The University Safety Officer functions under the Associate Vice Chancellor for Administration. In relation to the Radiation Safety Program, the University Safety Officer is responsible for:

1. Performing periodic audits of the radiation safety program to ensure that the RSO and all associated users are complying with all applicable Arkansas Department of Health regulations and the terms and conditions of the license (i.e., leak tests, inventories, use limited to trained approved users, etc.).
2. Determine compliance with rules and regulations, license conditions, and the conditions of project approval specified by the Radiation Safety Committee.

3. Ensure that all ancillary employees whose assigned duties may involve exposure to radioactive materials in the course of their employment are trained in Radiation Safety.
4. Serve as a member of the Radiation Safety Committee.

## **4.0 LICENSING AND REGISTRATION REGULATIONS**

### **4.1 FEDERAL REGULATIONS**

There are several areas in which the Federal Government retains regulatory powers in agreement states such as Arkansas.

1. The receipt, possession, use or transfer of by-product, source or special nuclear materials in quantities sufficient to form a critical mass.
2. The construction and operation of any production or utilization facility.
3. The export from or import into the United States of by-product, sources, special nuclear material, or electronic devices.
4. Any agency of the Federal Government.

In all other cases the Arkansas Department of Health, Division of Radiation Control and Emergency Management is given the power to license and regulate the receipt, possession, use and transfer of sources of ionizing radiation.

### **4.2 STATE REGULATIONS**

Because Arkansas is an agreement state, the Division of Radiation Control and Emergency Management of the Arkansas Health Department is empowered to license or register radiation sources and to enforce the regulations governing the activities of a licensee or registrant. Arkansas State University has been issued a specific broad scope license.

Within the conditions imposed by the Arkansas Department of Health through the Rules and Regulations, the licensee (ASU) is allowed to state what procedures it will follow in the safe use of radioactive materials. Our radioactive materials license therefore contains both state requirements and self-imposed operating procedures that have been approved by the state. When ASU is inspected, we are examined for compliance with both the Rules and the conditions of our license.

Copies of the Rules and Regulations for Control of Sources of Ionizing Radiation are on file in the following locations: Biology Department, Dean's Office - College of Science and Mathematics, and Environmental Health & Safety. The Radiation Safety Officer also has a copy

on file. A copy of these regulations may also be obtained by writing to the Division of Radiation Control and Emergency Management, Arkansas Department of Health, 4815 West Markham Street, Slot 30, Little Rock, Arkansas 72205-3867 or

[http://www.healtharkansas.com/rules\\_regs/rules\\_regs.htm](http://www.healtharkansas.com/rules_regs/rules_regs.htm)

Copies of the current radioactive materials license with all the amendments approved can be found in the Environmental Health & Safety Office and with Radiation Safety Officer.

### **4.3 ARKANSAS STATE UNIVERSITY CAMPUS REGULATIONS**

No person may use or transfer radioactive materials into or on the campus of Arkansas State University without prior approval by the Radiation Safety Committee.

All statements related to procurement, use and disposal of radioactive materials appearing in this booklet will be considered as the regulations for Arkansas State University, as they reflect the Rules and Regulations, the ASU license, and the policy decisions of the ASU Radiation Safety Committee. This manual is not intended to be a comprehensive reference. If further information is needed, consult the Arkansas Department of Health, Rules and Regulations for Control for Sources of Ionizing Radiation, the ASU license, or the Radiation Safety Officer.

### **4.4 POSTING OF NOTICES**

The Arkansas Department of Health (ADH) has adopted regulations with standards to protect you from hazards associated with radioactive materials, which are licensed by the ADH. The ADH requires that Arkansas State University post in a conspicuous place for all employees working in any portion of a restricted area a copy of RH-2824 "Notice to Employees" "Standards for Protection Against Radiation". See Appendix VII

## **5.0 APPROVED USERS**

### **5.1 PRINCIPAL USER**

Principal Users are those persons who are permitted by the Radiation Safety Committee to purchase, store and use radioactive materials under the Arkansas State University license (See Appendix II for Training and Experience Requirements). The Principal Users are responsible for the safe use of radiation sources by individuals under their control. The principal user is responsible for:

1. Compliance with the ASU rules and regulations for radiation safety and the State "Rules and Regulations for the Control of Sources of Ionizing Radiation".  
[http://www.healthyarkansas.com/rules\\_regs/rules\\_regs.htm](http://www.healthyarkansas.com/rules_regs/rules_regs.htm)
2. Obtaining approval of the Radiation Safety Committee prior to obtaining radioactive materials or carrying out a research protocol involving radioactive materials. A "Request to Use/Acquire Radioactive Materials" (Appendix IV) must be completed by the Principal user and must be approved by the RSC prior to beginning research.
3. Ensuring that all *authorized users* have successfully completed ENVR 4121/5121 and ensure that all *individual users* are currently enrolled in ENVR 4121/5121. All *principal users* must have completed the course or show documentation of equivalent knowledge or experience.
4. Developing protocols for the research/experiment, to ensure that appropriate safety precautions are taken.
5. Notifying the RSO prior to any personnel changes, including addition or termination of employees/students, or changes in operational procedures, new techniques, or changes of areas where radioactive materials may be used or stored.
6. Directing of personnel under their control to comply with all recommendations to wear pocket dosimeters, to survey their hands and clothing, to submit to bioassay, etc. which are designed to control and to reduce their total exposure.
7. Maintenance of required records of receipt, use, storage, and disposal of radioisotopes.
8. Segregation, containment, labeling, and proper disposal of all radioactive waste in accordance with guidelines.
9. Promptly notifying the Radiation Safety Officer of any accidents or incidents.
10. Ensuring that the personnel under their control discharge their individual responsibilities as listed in Section 5.4.

**NOTE:** Cleanup of contaminated equipment or areas is the responsibility of the principal user and the persons creating the contamination. It may **NOT** be assigned or delegated to staff outside the laboratory, such as custodial or maintenance workers.

## **5.2 AUTHORIZED USER**

An authorized user is a person who has been added to the Principal User's Authorization and has completed the appropriate training as outlined in Appendix II. The authorized user is responsible to the Principal User for all actions listed below for radioactive material. This user may work with isotopes or equipment without immediate supervision, and may assume limited responsibilities as defined by the Principal User.

### 5.3 INDIVIDUAL USER

An individual user is a person who works with radioactive material and has completed the required training as designated in Appendix II. The user must be listed on the Principal Users authorization list as an individual user, and is responsible to the Principal User for all actions listed below. The individual must work under direct supervision of the Principal User or an Authorized User designated by the Principal User.

### 5.4 RESPONSIBILITIES OF USERS

One of the basic tenets of safety is that all individuals must take responsibility for their own safety, and ensure that any actions taken do not constitute a hazard to others or to the environment. Each person at Arkansas State University who has any contact with sources of radioactive materials has the following responsibilities:

1. Keep exposure to radiation As Low As Reasonably Achievable (ALARA).
2. Expose liquid or other sources that will disperse in the atmosphere under fume hoods.
3. Wear the recommended radiation monitoring devices for personnel, such as pocket dosimeters and finger badges.
4. Use all recommended protective measures such as protective clothing, remote-handling tools. Mouth pipetting is prohibited.
5. DO NOT smoke, eat, drink, chew gum or tobacco, or apply cosmetics or contact lenses in an area where radioactive materials are used or stored. DO NOT store or prepare food or drink in any area that has been used for radioactive materials, e.g., refrigerators, cabinets, glassware. If food or empty food packaging is found in the normal trash, this is interpreted as "evidence of consumption" by regulators.
6. Maintain good housekeeping and clean working habits. Work surfaces must be covered with a plastic backed absorbent paper. Where practical, an impervious tray or pan should be used under the paper in order to ensure containment of spills. Working areas must be clearly delimited.
7. Survey work areas at least weekly when less than 200 Ci are used; otherwise survey daily at the end of each laboratory or work period.
8. Label radiation equipment and segregate radioactive waste and equipment to avoid cross contamination.
9. Report immediately to the Principal User and RSO the details of a spill or other accidents involving radioactivity.
10. Maintain a log of all meter and wipe surveys conducted by the user. (See Appendix V for Logbook Guidelines).

11. Carry out decontamination procedures when necessary and take the necessary steps to prevent the spread of contamination to other areas.

12. Clean hands when leaving the laboratory.

When using radioisotopes other than low energy beta emitters, the following extra precautions are required:

13. Place all sources behind suitable shielding.

14. Survey hands, feet, clothing and personal materials at the end of each laboratory or work period.

15. Monitor radiation with a survey meter when radioisotopes are being used.

## **6.0 PROCUREMENT, RECEIPT AND INVENTORY OF RADIOACTIVE MATERIALS**

### **6.1 PURCHASES**

The Principal User must submit to the Radiation Safety Officer a "Request to Use/Acquire Radioactive Material" form detailing the description of the radioactive material, sources or equipment to be ordered, intended use and planned disposal. The description shall indicate the radioisotope, its chemical and physical form, and the total activity in Becquerels, millicuries or microcuries. Before committee discussions, the RSO checks to insure that all requested radioisotopes are authorized by ASU's license and do not exceed the authorized possession limits.

The Radiation Safety Committee will then check each request for proper use of radioisotopes. The deliberations will include:

1. Whether the training and experience of the proposed user(s) are adequate for the proposed purposes and for possible emergency procedures.
2. Ensure the available facilities and equipment (or those to be obtained) do not compromise safety and are adequate for the stated needs.
3. Review proposed use to ensure all federal, state, and local safety requirements will be met.
4. Review the operating, handling, and emergency procedures to ensure they are adequate for this material.

After approval by the RSC, ordering information is provided to the University purchasing agent, including instructions to have the material sent directly to the Radiation Safety Officer, Arkansas State University, 117 South Caraway Road, Jonesboro, Arkansas 72401. Arrangements must be

made for delivery to occur during normal working hours. Packages must not be sent to Central Receiving.

## **6.2 RECEIPT OF RADIOACTIVE MATERIALS**

Upon arrival of the radioisotope (this includes radioisotopes brought to campus personally by a Principal User) the Radiation Safety Officer will check the package for contamination and enter the radioisotope into the inventory (in accordance with RH-1307). Only then will the RSO notify the Principal User of satisfactory receipt and availability of material.

The areas designated for receipt and inspection of newly delivered radioisotopes is LSE 102 E and LSE 303B. Within three hours of receipt, the package is swipe tested, unpacked and checked for shipping damage. A Radioactive Receipt Form is completed and the material is logged in and stored until delivery to the authorized user.

A member of the Radiation Safety Committee is on call to receive packages when the Radiation Safety Officer is unavailable.

## **6.3 TRANSFER OF POSSESSION**

Outside Agencies - All radioactive material must enter and exit the campus through the Radiation Safety Officer. Before material may be released to anyone not directly associated with Arkansas State University, the RSO will be notified of the desired transfer. The RSO will ensure that all federal and state regulations are followed, in accordance with RH-501 of the ADH Rules and Regulations. The following information must be provided prior to the transfer taking place:

1. Name of institution receiving radioactive material and a written certification from that institution identifying authorization to receive the type, form and quantity of radioactive material to be transferred. The certification must also include the current license number, expiration date and issuing agency name.
2. Name of Radiation Safety Officer at receiving institution.
3. Isotope, chemical compound, and amount of activity.

This is necessary for compliance with Arkansas State University license and to avoid potential legal prosecution. A documented record of all such transactions will be maintained by the RSO in accordance with RH-3200 of the ADH Rules and Regulations set forth by the Department of Transportation, 49 CFR Parts 170 through 189. The Radiation Safety Officer will prepare the package for shipping.



Interdepartmental - Internal transfer of radioactive material will be approved by the RSO. These transfers must be between committee-approved principal users. The recipient will have a current authorization for the same radioactive material. Receipts of such transfers will be maintained by the parties involved and by the RSO.

## **6.4 SECURITY AND STORAGE OF RADIOACTIVE MATERIALS**

### **6.4.1 SECURITY**

The Arkansas Department of Health rules and regulations require that security of radioactive materials must be in place at all times. Violations of this regulation are frequently cited at institutions utilizing radioactive materials, and place the license to use such materials in jeopardy. Section RH-1308, of the state Rules and Regulations reads:

(a) The Licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.

This means that in all locations where radioactive materials are present the trained user must be in constant attendance. Otherwise the lab must be locked or secured to prevent unauthorized removal or access. If the laboratory is unoccupied access to the lab **MUST BE LOCKED**.

### **6.4.2 STORAGE:**

Radioactive materials shall be stored in sealed containers in such a way as to prevent accidental spillage or breakage, and to prevent release into the air. If the material requires shielding, it shall be stored in shielded containers in order to prevent doses to personnel accessing the storage areas.

If the radioactive material has been stored in a freezer or ultra freezer, it is recommended that the material be thawed, opened and handled in a certified fume hood or biological safety cabinet. Aerosols from stored radioactive materials may cause contamination of adjacent areas and doses to personnel if not handled in the proper way after storage. All radioactive materials, whether in storage, waste or use, must be labeled with the radioactive warning symbol and the words "Caution, Radioactive Materials".

## **7.0 RULES FOR THE SAFE HANDLING OF RADIOACTIVE MATERIALS**

### **7.1 CLASSIFICATION OF AREAS**

All rooms or areas in which licensed quantities of radioactive materials are used or stored must be posted with a "Caution Radioactive Material" sign and a "Notice to Employees".

#### **7.1.1 UNRESTRICTED AREAS**

An unrestricted area is any area to which access is not controlled by the licensee or principal user for the purposes of protection of individuals from exposure to radiation and radioactive materials. An area is unrestricted and does not require control measures:

1. if an individual continually present in the area cannot receive more than 0.0002rem (0.02 mSv) in any one hour or 0.05 rem (0.5 mSv) in a calendar year; and
2. if, when allowance is made for expected occupancy and time variations in dose-rate, no individual is likely to receive more than 500 mrem (5 mSv) in a calendar year.

Radioisotopes may be transported through an unrestricted area, but may not be used in an unrestricted area.

### **7.1.2 CONTROLLED AREA**

A controlled area is outside of a restricted area, but inside the site boundary. A controlled area in which radioisotopes are used and access is limited, but the potential exposure rates fall well below the limits that define a Restricted Area.

### **7.1.3 RESTRICTED AREAS**

All areas within the University in which dose levels do not conform to the standard for unrestricted areas shall be restricted and under the control of the Radiation Safety Officer for radiation safety purposes. The approved user responsible for work with radioisotopes in that area shall be responsible for controlling access to the area. Both Federal and State regulations define restricted areas containing radiation requiring special control measures as follows:

1. Radiation Area - An area accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in any one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. A sign bearing the radiation symbol and the words "Caution Radiation Area - No Entrance to Unauthorized Personnel" is to be posted at the entrance.
2. High Radiation Area - An area accessible to individuals in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem ( 1 mSv) in one (1) hour at thirty (30) centimeters from the radiation source or thirty (30) centimeters from any surface that the radiation penetrates. A sign bearing the radiation symbol and the words "Caution High Radiation Area - No Entrance to Unauthorized Personnel" is to be posted at the entrance.
3. Very High Radiation Area - any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads \* (5 gray) in one hour at one meter from the radiation source or from the surface that the radiation penetrates.

**\*NOTE** - At Very High doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts).

Within the restricted area, strict surveillance should be maintained to assure that significant exposure levels are not present, whether in the form of contamination, airborne levels of radiation or external exposure levels.

## 7.2 RADIATION DOSE LIMITS

### 7.2.1 ALARA

ALARA is an acronym meaning As Low As Reasonably Achievable. It is a requirement in the law for all facilities possessing radioactive materials licenses to have a formal ALARA program. The radiation protection standards set forth in this manual are used to control radiation exposure to all personnel occupationally exposed to radiation. It is the policy of Arkansas State University to keep this exposure as low as reasonably achievable (ALARA).

### 7.2.2 OCCUPATIONAL DOSE LIMITS

Occupational dose limits to individual adults shall be in accordance with RH-200 of the Arkansas Department of Health, Rules and Regulations. No individual may receive in one calendar year, except for planned special exposerers, a total occupational exposure in excess of the following:

Total Effective Dose	5 rems (0.05 Sv), or
Sum of deep-dose equivalent and committed dose equivalent to any individual organ or tissue other than the lens of the eye	50 rems (0.5 Sv)
Lens of the eye (lens dose)	15 rems (0.15Sv) and
Skin & extremities	Shallow dose equiv. of 50 rems (0.50Sv)

DE – Dose Equivalent. The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

CDE – Committed Dose Equivalent ( $H_{T,50}$ ). The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

EDE – Effective Dose Equivalent ( $H_E$ ). The sum of the products of the dose equivalent to the organ or tissue ( $H_T$ ) and the weighting factors ( $w_T$ ) applicable to each of the body organs or tissues that are irradiated ( $H_E = \sum w_T H_T$ ).

CEDE – Committed Effective Dose Equivalent ( $H_{E,50}$ ). The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ( $H_{E,50} = \sum w_T H_{T,50}$ ).

DDE – Deep Dose Equivalent ( $H_d$ ), (which applies to external whole-body exposure). The dose equivalent at a tissue depth of 1 cm (1000 mg/cm<sup>2</sup>).

TEDE – Total Effective Dose Equivalent. The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

SDE – Shallow-dose Equivalent ( $H_s$ ), (which applies to the external exposure of the skin or an extremity). - The dose equivalent at a tissue depth of 0.007 centimeter (7mg/cm<sup>2</sup>), averaged over an area of one (1) square centimeter.

LDE – Lens of Eye Dose Equivalent. Applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm<sup>2</sup>).

### **7.2.3 MINORS WORKING WITH RADIOACTIVE MATERIALS**

The annual occupational dose limits to minors, (individuals under the age of 18) must be limited to ten percent (10%) of the annual dose limits specified for adult workers. For these workers/students, safety training must be completed prior to work with radioactive materials as with other occupational workers and students.

### **7.2.4 EXPOSURE LIMITS FOR THE GENERAL PUBLIC**

Any person who is not regularly employed or authorized in using radioactive materials must not receive a radiation dose in excess of either:

- 0.1 rem (1 mSv) in any one year.
- 0.002 rem (0.02 mSv) in any one hour.

### **7.2.5 EXPOSURE LIMITS TO AN EMBRYO/FETUS**

Arkansas State University incorporates radiation dose guidelines, in accordance to RH-1207 of the ADH Rules and Regulations, for ensuring safe radiation limits for the embryo/fetus of occupationally exposed employees. Pregnant radiation workers who wish to declare their pregnancy should notify the Radiation Safety Officer in writing as soon as possible after learning of their pregnancy.

The regulatory dose limit to the embryo/fetus of a declared pregnant woman is 0.5 rem (5 mSv) for the entire pregnancy period.

The dose equivalent to the embryo/fetus is the sum of the deep-dose equivalent to the declared pregnant woman and the dose equivalent to the embryo/fetus resulting from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

### **7.3 PERSONNEL MONITORING**

Personnel monitoring of exposure to radiation and radioactive materials shall be performed to demonstrate compliance with the occupational dose limits. As a minimum, individual monitoring devices will be required where:

1. An individual receives or is likely to receive in one year from sources external to the body, a dose in excess of ten (10) percent of the applicable limits (Section 7.2.2).
2. An individual enters a high or very high radiation area.
3. A minor or declared pregnant woman is likely to receive, in one year, from sources external to the body, a dose in excess of ten (10) percent of the applicable annual limit RH1206 or RH1207, Arkansas Rules and Regulations; and
4. A declared pregnant woman is likely to receive during the entire pregnancy from radiation sources external to the body, a deep dose equivalent in excess of 0.1 rem (1 mSv) (All of the Occupational Doses in Section 7.2.2 continues to be applicable to the declared pregnant worker as long as the embryo/fetus dose limit is not exceeded.)

#### **7.3.1 DOSIMETERS**

The principal user is responsible for seeing that each person under his/her control is issued a radiation dosimeter when his/her activities may result in exposures greater than the annual dose limits outlined in Section 7.2.

Types of dosimeters include film badges, thermoluminescent dosimeters (TLDs), and pocket dosimeters. Users working with gauges, which are sources of gamma and neutron radiation, must wear a whole body badge on the torso of the body. This badge must never be shared with another individual and be used only for occupational (or class) exposure monitoring. The University will supply film badges or TLDs; one of these types of monitors must be obtained from an accredited dosimetry service approved by the Arkansas Department of Health.

Pocket dosimeters will be worn and readings will be recorded to obtain daily measurement of exposure dose under the conditions required by RH 1302 of the ADH Rules and Regulations. Film badges or TLD's must be turned in as mandated by the Arkansas Department of Health for determining dose. Reading must be recorded daily when entering and after leaving the area to obtain a daily measurement of exposure dose.

The pocket dosimeters will be calibrated (semiannually) and periodically checked.

### 7.3.2 BIOASSAYS

The Radiation Safety Officer will request a bioassay if an individual's dose, determined by area contamination or pocket dosimeter, warrants a further medical check, or if a bio-contamination type accident occurs. If the quantity of H-3 or other biohazardous radioisotopes used is large enough (more than 0.1 mCi) to suggest a possible hazard, a bioassay procedure will be instituted (See Appendix IX "Guidelines for Bioassays").

**IF YOU SUSPECT THAT YOU HAVE RECEIVED A SIGNIFICANT EXPOSURE, CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY.**

### 7.4 POSTING OF LABORATORIES AND AREAS

All lab areas that contain radioactive material will be indicated by the posting of the standard trefoil warning sign at the entrance to the laboratory. Address and telephone numbers of the principal user involved with the lab will be clearly indicated thereon. Signs are required by regulation to denote areas or containers with levels of radiation or radioactivity specified in the following sections:

**Radiation Areas:** Each radiation area shall be conspicuously posted with a sign or sign bearing the radiation symbol and the words "**CAUTION RADIATION AREA**" in areas accessible to personnel in which the total effective dose received in any one hour exceeds 0.002 rem (0.02 mSv) and 0.05 rem (0.5 mSv) in a year.

**High Radiation Areas:** Each high radiation area shall be posted with a sign or signs bearing the radiation symbol and words "**CAUTION HIGH RADIATION AREA**". In addition, one or more of the following features must be utilized at the entrance or access point to the high radiation area:

- A control device that upon entry causes the level of radiation to be reduced below the level at which an individual might receive a deep-dose equivalent of 0.1 rem (1mSv) in one (1) hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
- A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or
- Entryways that are locked, except during periods when access to the area is required, with control over each individual entry.

**Very High Radiation Areas:** Each area in which there may exist radiation levels in excess of 500 rads (5 grays) in one (1) hour at one (1) meter from a radiation source or any surface through which the radiation penetrates must be posted with a sign or signs bearing the radiation symbol and "**GRAVE DANGER, VERY HIGH RADIATION AREA**". Each entrance or access point must be equipped with entry control devices which function automatically to prevent any individual from inadvertently entering the area when very high radiation levels exist.

**Radioactive Materials:** Each laboratory or area where radioactive materials are used or stored must be posted at the entrance with a "CAUTION RADIOACTIVE MATERIALS" sign. Entry and area warning signs are to be posted and removed only after notifying the RSO.

Refrigerators, freezers, and other "in lab" storage areas, and containers in which materials are stored or transported must have a visible label with the radiation caution symbol and the words "Caution Radioactive Materials". The label should also state the kind and approximate quantity (e.g. "< 250 Ci) of radioactive material in the container.

**AIRBORNE RADIOACTIVITY AREAS:** The Radiation Safety Officer must give approval prior to any research utilizing airborne radioactive materials. Any room, area or enclosure in which airborne radioactive materials exist in concentration excess of the amounts specified in RH 2200, Appendix A, Table 1, Column 1 of the ADH Rules and Regulations.

## **7.5 POSTING OF EQUIPMENT**

All vessels containing radioactive materials will be clearly marked with radiation warning tape and/or labels stating:

- 1) Radioisotope
- 2) Chemical Form of the Radioisotope
- 3) Total Activity at date of purchase
- 4) Date of Purchase

All glassware used in experiments involving radioisotopes will be labeled with radiation warning tape, with the particular radionuclide(s) inscribed thereon, until the vessel has been decontaminated and checked for radiation.

## **7.6 VACATING LABORATORY SPACES**

The Radiation Safety Officer must be informed of all changes in authorized laboratory spaces. Upon notification, the Radiation Safety Officer will conduct a clearance survey. Radiation Warning Signs can only be removed by the Radiation Safety Officer.

## **8.0 SURVEYS**

The Radiation Safety Officer will make annual independent surveys (audits) of all active radioisotope laboratories. Surveys of laboratory work surfaces and floors will be performed regularly when the laboratory is in use. Labs may be audited on a more frequent schedule depending on the amount of radioactivity in use. Such things as inventory assessment, contamination control, and waste disposal practices will be addressed during these audits.

Survey (audit) results will be forwarded to the authorized user, and a recheck may be conducted in the event problems have been detected that need corrective action.

## **OPERATING PROCEDURES TO BE UTILIZED BY RSO**

1. The following areas will be swipe tested and surveyed at the intervals indicated:

- a.) Areas in which radioactive wastes are stored at least monthly
- b.) Areas in which sealed sources are stored or used: every 6 months
- c.) Areas authorized for use with radioactive materials in which no radioactive materials have been used or stored during the previous month will not be swipe tested or surveyed until actual use has resumed.

Areas in which less than 1 mCi of radioisotopes of low energy (<0.3 MeV) have been used will not require survey with a hand held survey meter.

2. Swipes will each cover a 100 cm<sup>2</sup> area. Each swipe will be counted by liquid scintillation counting or other instrument in a low background area.

### **8.1 USER GUIDELINES FOR CONDUCTING SURVEYS**

1. Surveys will be conducted each day that loose or uncontained radioactive material is used. Use areas will be swipe tested and surveyed with a survey meter (if appropriate for the radioisotope) after use for the purpose of detecting contamination. Areas in which only small quantities of radioactive material (less than 200 Ci) are used will be surveyed weekly, rather than daily. Swipe tests will be done after a known or suspected spill of radioactive material. Areas where the contamination level exceeds 200 dpm/ 100 cm<sup>2</sup> or is found to be twice background will be decontaminated and retested.

2. Swipes will each cover a 100 cm<sup>2</sup> area. Each swipe will be counted by liquid scintillation counting or other instrument in a low background area.

3. Prior to disposing of radioactive material, a survey will be performed of all material that will be disposed to ensure that radiation levels are at or below background. Measurement will be performed with an appropriate instrument. All records of disposal will be kept until the ADH terminates the license.

4. Records of all surveys must be maintained for a minimum of 3 years after the record is made, for review in accordance with RH-1500 of the ADH Rules and Regulations. The minimum information will include:



- a.) Location, date and identification of equipment used, including the serial number, calibration date and pertinent counting efficiencies.
- b) Name of person conducting the survey.
- c) Drawing of area surveyed, identifying relevant features such as active storage areas, active waste areas, etc.
- d) Measured exposure rates, keyed to location on the drawing (point out rates that require corrective action).
- e) Detected contamination levels, keyed to locations on drawing.
- f) Corrective action taken in the case of contamination (as defined above) or excessive exposure rates (exposures likely to exceed 10% of the exposure limits defined in RH-1200 of the ADH Rules and Regulations); reduced contamination levels or exposure rates after corrective action, and any appropriate comments.

## **8.2 CONTAMINATION LEVELS**

Removable surface contamination levels shall be controlled such that a level of 200 dpm per 100 cm<sup>2</sup> is not exceeded. When removable radioactivity is found above the set limit, the area must be decontaminated and then re-surveyed and documented. Nonremovable contamination should be labeled and shielded whenever possible in order to maintain ALARA limits.

It is understood, that certain areas may be routinely contaminated, such as internal parts of equipment and inside areas of glassware, and that it may not be practical to decontaminate these surfaces after each use. The equipment should be monitored routinely and cleaned periodically. Signs must be posted and protective clothing and gloves should be used when in contact with these areas.

Radioactive contamination levels of air and water in restricted areas must be controlled such that the levels specified in RH 2200 Appendix A, Table I, of the ADH Rules and Regulations are not exceeded. In unrestricted areas, contamination levels of air and water shall not exceed those specified in RH 2200, Appendix A, Table II.

## **8.3 LEAK TESTS**

A sealed source is radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling (RH-200.av).

Each sealed source, other than Hydrogen-3 (Tritium) with a half-life greater than thirty (30) days and in any other form other than gas shall be tested for leakage and/or contamination prior to initial use and at six month intervals. If there is reason to suspect that a sealed source might have

been damaged, it shall be tested for leakage before further use. In accordance with RH 1212 of the ADH Rules and Regulations.

Leak tests shall be capable of detecting the presence of 0.005 microcurie of removable contamination. Any test which reveals the presence of 0.005 microcurie or more of removable contamination shall be considered evidence that the sealed source is leaking. The source should be decontaminated and repaired or disposed of. The RSO will file a report with the ADH within five days of the leak test describing the equipment involved, the test results and the corrective action taken.

#### **8.4 SURVEY INSTRUMENTS AND CALIBRATION**

To facilitate safe practice in the University, the Radiation Safety Committee requires that an appropriate calibrated survey meter be available to users. The calibration procedures will be conducted by the RSO in accordance to the Arkansas State University license.

Instruments must be calibrated at least annually and after servicing. Calibrations will be performed by the RSO or the manufacturer utilizing radionuclide sources. The Radiation Safety Officer must be informed prior to the purchase of a new instrument or repair and factory calibration of an existing instrument.

If the instrument contains an internal radioactive standard, the Radiation Safety Officer must be notified prior to disposal of the instrument, so that proper inventory and disposition can be assured.

#### **9.0 RADIOACTIVE WASTE**

All radioactive waste must be disposed of in accordance with State Rules and Regulations. Actual disposal of wastes must be carried out by a Principal or Authorized User or by an Individual User under the direct supervision of a Principal or Authorized User. Waste disposal protocols must be approved in advance by the Radiation Safety Committee as part of a Principal Users application. Complete records of all waste disposals must be maintained. Detailed regulations for waste disposal are found in sections RH-1400 through RH-1407 of the ADH Rules and Regulations.

##### **9.1 DECAY IN STORAGE**

Waste containing radioisotopes with short half-lives may be stored in an area approved by the Radiation Safety Committee until the radioactivity has decayed to background levels. Liquid wastes must be stored in plastic containers, and solid wastes must be stored in a plastic barrel lined with a plastic bag and covered with a lid. All wastes must be clearly labeled as radioactive with the radioisotope indicated. It is the responsibility of the user to wipe test the waste storage area monthly to ensure no leakage of wastes and record results in a logbook. After the amount of residual radioactivity has been determined to be at background levels and this information

recorded, liquid wastes may be poured down a laboratory sink and solid wastes should be carefully and securely wrapped and placed in a normal wastebasket.

## **9.2 DISPOSAL OF LIQUID WASTES**

The ADH Rules and Regulations for disposal of liquid wastes are such that this is the least expensive and most preferred method of radioactive waste disposal. The regulation that limits release of radioactive materials into uncontrolled areas is RH-1210; actual limits for disposal of radioactive wastes to the sewer system are found in RH-2792. In calculating whether disposal of radioactivity in this manner is permitted, please note that the volume of water leaving the ASU campus in a month is approximately 38,000,000 liters. The radioactivity in liquid wastes must be readily soluble (or readily dispersible biological material) in water. Radioactive material can only be disposed into the sewer system through a designated, well marked sink that has been approved by the Committee in the user's application. Radioactivity contained in scintillation vials can also be disposed via the sewer system as long as it does not contain ingredients that cause disposal to be in violation of EPA or other agency regulations for the control of hazardous chemicals. The committee recommends the use of so-called biodegradable scintillation fluid for this reason. Scintillation vials that can not be disposed in this manner must be accumulated as solid waste and transferred to a licensed radioactive waste hauler for transport and disposal.

## **9.3 DISPOSAL OF SOLID WASTE**

Radioactive material that cannot be dissolved in water or decayed in storage must be treated as solid waste. This generally entails transfer of control to a low-level waste processor for disposal. Disposal in this manner is expensive, and details of the process are found in RH-1406. in the Rules and Regulations.

## **9.4 DISPOSAL OF ANIMAL WASTE**

Radioactive animal tissue may be disposed without regard to radioactivity or incinerated if the amount of radioactivity is below 0.05 microcuries (1.86kBq) or less Hydrogen-3, Carbon-14, and Iodine-125 per gram averaged over the weight of the entire animal. This manner of disposal requires careful documentation of the amount of radioactivity. Dead animals or animal tissue must be double bagged and disposed in an outside dumpster or you may contact the Environmental Health & Safety Department at extension 2862 for procedures relating to incineration of animals or animal tissue.

Regardless of the radioactivity involved, the user is responsible for complying with all applicable federal, state, and local regulations relating to disposal of hazardous or toxic materials.

## **10.0 EMERGENCY PROCEDURES**

In any radiation emergency, personnel protection and emergency medical care have priority over radioactive decontamination of the building and equipment. For all cases, contact the Radiation Safety Officer 870-972-3082, after hours 870-932-3739 who must be notified as soon as

possible.

Arkansas State University must notify the Arkansas Department of Health as soon as possible but not later than four (4) hours after the discovery of an event that may allow unnecessary exposure to or release of radiation or licensed radioactive material in excess of regulatory limits. Events may include fires, natural disasters, explosions or toxic gas releases, etc.

## 10.1 ACCIDENT PROCEDURES

In emergency or accident situations involving radioactive material, the following steps should be taken.

**1. Restrict Access:** Persons in the immediate area should be asked to leave the area. Establish a restricted area boundary, limiting access to the area to authorized personnel only.

**2. Maintain Surveillance:** The restricted area must be kept under constant, direct observation.

### **3. Notify:**

- The Radiation Safety Officer 972-3082 or 932-3739
- If the incident falls under the requirements of Paragraphs RH-1501 and/or RH-1502 of the Arkansas Rules and Regulations for Control of Sources of Ionizing Radiation, the Arkansas Department of Health must also be notified 1-501-661-2136.
- In the event of any transportation accident involving radioactive material, both the Arkansas Department of Health and the Arkansas State Police **MUST** be notified.

**IMPORTANT: DO NOT HANDLE UNATTACHED OR UNSHIELDED SOURCES OF RADIOACTIVE MATERIAL. Decontamination and recovery operations should only be attempted by properly trained individuals, under the direct supervision of the Radiation Safety Officer and using proper handling tools.**

## 11.0 VIOLATIONS SUSPENSIONS, AND APPEALS

The Committee, the Radiation Safety Officer, or the University Safety Officer can initiate investigations of safety violations. The Committee may request the Radiation Safety Officer to make special investigations of any facilities where radiation sources are used.

### 11.1 VIOLATION PROCEDURES

Upon investigation, should the Radiation Safety Officer find any violations, the following guidelines will be utilized:

1. Verbal warning to user, outlining deficiencies found and how these deficiencies should be corrected.
2. Follow-up investigation to be conducted within 30 days of verbal warning. Failure to correct prior violations will result in a written warning, requiring the Principal User to provide a written response as to how the deficiencies have been corrected.
3. A follow-up investigation will be conducted within 30 days of the second audit. Failure to meet conditions one and two which are previously listed will result in loss of user privileges.

The Radiation Safety Committee or the Radiation Safety Officer reserve the right to revoke the user's authorization, at any time, if in the Committee's opinion or the Radiation Safety Officers opinion, the health or safety of persons or property are placed in immediate danger.

# APPENDIX I

## RADIATION SAFETY COMMITTEE MEMBERSHIP

**Dr. Andrew Sustich, Ph.D., Chair, Radiation Safety Committee, (Dean of Graduate School)**  
([sustich@astate.edu](mailto:sustich@astate.edu))

**Ron Johnson, PhD., RSO, Biological Sciences** ([rlj@astate.edu](mailto:rlj@astate.edu))

**Ben Rougeau, DVM, Assistant RSO, Chemistry & Physics** ([brougeau@astate.edu](mailto:brougeau@astate.edu))

**David Gilmore, Ph.D., Biological Sciences** ([dgilmore@astate.edu](mailto:dgilmore@astate.edu))

**Starr Fenner, MPA, CHMM, Director Environmental Health & Safety**  
([sfenner@astate.edu](mailto:sfenner@astate.edu))

**Richard Grippo, Ph.D., Biological Sciences** (<mailto:rgrippo@astate.edu>)

**Ray Winters, M.S., RT (R) (CT), Health Professions** ([rwinters@astate.edu](mailto:rwinters@astate.edu))

**Li, Bao, Ph.D., Chemistry and Physics** ([bali@astate.edu](mailto:bali@astate.edu))

# APPENDIX II

## ACCEPTABLE TRAINING AND EXPERIENCE REQUIREMENTS FOR USERS OF RADIATION SOURCES

**1. Principal User:** This individual is expected to be faculty wishing to utilize radioisotopes in teaching or research. To be approved as a principal user, an individual must demonstrate previous experience or successfully complete ENVR 4121/5121 Radiation Safety.

Demonstration of previous experience can consist of a training certificate from another institution, first authorship on a paper in which radioisotopic use was a major component of the research methods, or a passing score on an exam administered by the RSO based on material taught in ENVR 4121/5121. Individuals without previous experience must successfully complete the radiation safety course. ENVR 4121/5121 Radiation Safety includes the following subject areas:

- A) radiation terminology
- B) basic radiation physics
- C) biological effects of radiation
- D) radiation instruments
- E) radiation in every day life
- F) regulations and responsibilities
- G) standard safety procedures
- H) emergency procedures

**2. Authorized user:** This individual is expected to be a student or staff member working with radioisotopes under the authority of a Principal user. To become an Authorized user, an individual must successfully complete ENVR 4121/5121 and be approved by the Radiation Safety Committee. An Authorized user may work with radioactive material without direct supervision and may be designated to supervise an individual user.

**3. Individual user:** This individual is expected to be a student working with radioactivity under the direct supervision of a Principal or designated Authorized user. Direct supervision means that a supervisor is present and attentive to the activities of the individual user. Allowing an Individual user to work unsupervised is a violation of the license and could result in the termination of the project. An Individual user must receive adequate training from the RSO, the USO, or the principal user, and this training will be documented by an exam given by the RSO covering most of the same topics listed above but in lesser depth. Informal instruction by the Principal user and enrollment and satisfactory progress in ENVR 4121/5121 prior to handling radioisotopes will also be considered for approval by the Radiation Safety Committee.

**4. Ancillary personnel:** These are individuals with access to controlled areas (faculty, students, and staff such as housekeeping) that do not work with radioactive materials. All individuals with such access will receive simple, documented training on the basics of radiation safety from the USO. Any individuals who do not agree to be trained or violate regulations will have their access to these areas revoked.

## APPENDIX III

### Inventory & Disposal Log for Radioactive Material

<b>Sample Inventory</b>							
Date Received: 23 Dec 2006			Isotope	C-14		Activity (uCi): 250 uCi	
PO #	DO2314		Form:	Butyric Acid		Volume (mL): 2.5 mL	
Date	User		Amount Used		Balance		
			ml / uCi		mL / uCi		
25-Dec-2006	Hilburn, Doe		25 uCi/ 0.25 mL		225 uCi / 2.25mL		
23-Jan-2007	Public , John Q		40 uCi / 0.40 mL		185 uCi / 1.85 mL		
For Items not used monthly, an amount must be entered into the balance column for the month.							



Disposal Log							
Use separate container for Separate isotopes							
Isotope	C-14						
Form:	Butyric Acid		Material Added		Total Acitivity		
			ml / uCi		mL / uCi		
30-Dec-2006	Hilburn, Doe		25 uCi / 0.25 mL		225 uCi / 2.25mL		
25-Jan-2007	Public , John Q		40 uCi / 0.40 mL		265 uCi / 2.45 mL		

# APPENDIX IV

## REQUEST FOR APPROVAL TO USE and ACQUIRE RADIOACTIVE MATERIAL

Date: \_\_\_\_\_ Principal User: \_\_\_\_\_

Department: \_\_\_\_\_ Campus Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Radioisotope (type, max. amount, and chemical form):  
\_\_\_\_\_

Expected Period of Use:  
\_\_\_\_\_

1. On an attached sheet, describe how and where the radioisotope will be used. Include an outline of the research protocol in sufficient detail for the Committee to review. Include the equipment which may be used, handling procedures, the types of waste that will be generated, and how the waste will be disposed in accordance with state and federal regulations and ASU policy.

Include a list of expected authorized and individual users whom you expect to be working on this project.

2. Your signature below indicates that you have read, understood, and agreed to the following:

- I will comply with all policies, rules, and regulations as outlined in the ASU Radiation Safety Manual, the ASU Radioactive Materials License, and the "Rules and Regulations for Control of Sources of Ionizing Radiation" of the state of Arkansas.
- I assume all the responsibilities of Principal user as outlined in the ASU Radiation Safety Manual.
- I will maintain all necessary records to document use and disposal of radioactive materials.
- All radioactive materials sent or brought to campus must be shipped directly to the RSO and not to Central Receiving to check for contamination and for addition to the inventory.
- The RSO will inspect and swipe test my facility at least twice yearly.

- ❑ I and my project are responsible for the cost of all cleanup/disposal/testing required/recommended by the RSO or by state or federal authorities.

.. \_\_\_\_\_

Signature

Date

Transmit original and 6 copies to ASU Radiation Safety Committee, c/o Ron Johnson, RSO, P.O. Box 519, Dept. of Biology (ext. 3082).

RSC use only:   Approved            Tabled for clarification            Rejected

Conditionally approved if \_\_\_\_\_

\_\_\_\_\_

RSO Signature

Date

T

## APPENDIX V

### LOGBOOK FOR RADIOACTIVE MATERIAL

Each Principal user must maintain a logbook in the laboratory that contains records of radioisotope use, and disposal. The log book must be separate of other lab notebooks and readily accessible to the RSO or other inspectors.

#### Contents:

##### 1) Log of Radioactive Materials On Hand

Every time radioactive material is **received**, the following information must be entered into the log: Isotope, chemical form, amount (Ci or mCi), volume, and date of arrival. Each entry must be on a separate page with ample room after the entry to record changes in amounts during usage.

Every time radioactive material is **used**, the following information must be entered into the log: Date of use, the volume (or mass) of material used, the volume (or mass) disposed, and the volume (or mass) remaining. At least once a week, the remaining balance of radioactivity must be entered; decay of short half life radioisotopes must be taken into account.

##### 2) Log of Swipe Tests

Swipe tests must be performed at least weekly when using 200uCi or less. Workers using in excess of 200 uCi in a day must perform swipe tests daily at the conclusion of the experiment. The logbook should contain a map of the laboratory with radioactive use areas clearly indicated.

Numbered swipe tests should be keyed to the map and the areas briefly described. It is highly recommended that the same core swipe areas be numbered the same from week to week. Core areas should include the work area, around the work area, any sink for radioactive disposal, and high traffic areas that may have been contaminated (floor near door, doorknobs, telephone). Additional locations should include any place a spill may have occurred (bench, floor) or places that have been handled (lid of micro fuge, controls for gel dryer). Background (paper disk in scintillation fluor) should be determined each time; you may use the same background vial over and over. Vials that register background levels can be utilized for repeated swipe tests.

Swipe tests twice background must be redone following decontamination of the affected area. Swipe test data must be dated and legibly entered into the log. Scintillation counter printouts may be saved as additional documentation.

## Sample Log

S-35

<u>Date</u>	<u>Activity</u>	<u>Volume</u>	<u>Disposal</u>	<u>Balance</u>
		<u>Used</u>	<u>Volume</u>	<u>Activity</u>

4/26/99 received S-35 Methionine 0.5 ml 0.5 mCi

4/28/99 used to label cultures 0.1 ml all-sink 0.4 ml

4/30/99 used to label cultures 0.1 ml all-sink 0.3 ml

5/3/99 inventory 0.3 ml 0.28 mCi

5/10/99 inventory 0.3 ml 0.27 mCi

5/12/99 used to label cultures 0.1 ml all (sink) 0.2 ml

5/7/99 received S-35 Na sulfate 1 ml 1 mCi

5/14/99 inventory 1 ml 0.95 mCi

# APPENDIX VI

## Appendix F

### PERSONNEL MONITORING

#### I. PERSONNEL MONITORING

Personnel monitoring devices, more commonly referred to as personnel monitoring badges, shall be provided to measure the radiation dose for all individuals who are likely to receive more than 10% of the annual dose limit permitted by the Rules and Regulations for Control of Sources of Ionizing Radiation, Paragraph RH-1200, "Occupational Dose Limits for Adults." The whole body radiation dose limit which requires personnel monitoring is 500 millirem per year or greater.

However, an Applicant may provide calculations which demonstrate that an individual is not likely to exceed the dose limit and is not required to be provided personnel monitoring. Instructions for estimating an individual's annual radiation dose is provided in Attachment 1 of this Appendix.

Complete Form F, Personnel Monitoring Program, describing the proposed radiation dose monitoring program and submit the completed form with the application.

#### II. DESCRIPTION OF PERSONNEL MONITORING DEVICES

##### A. General

Personnel monitoring badges must detect beta, gamma and neutron radiation, so verify the capabilities of available badges before making a selection. Dosimetry processors must hold accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology. A list of NVLAP accredited dosimetry vendors is available on the Internet at [www.nist.gov](http://www.nist.gov).

Each order of badges includes a control badge for measuring the amount of background radiation the badges receive each monitoring period. This enables the background to be subtracted from the total reading to provide an accurate record of each worker's occupational radiation dose. When not in use the badges should be stored with the control badge to ensure accurate dosimetry records. The control badge must be stored in a low background radiation location and must be returned with the other badges each monitoring period.

**B. Film Badges**

Film badges are small pieces of x-ray film contained in a plastic holder. The film darkens in proportion to the amount of radiation it has been exposed to, so measurements of the film density provides a measurement of the wearer's radiation exposure. Film badges should be protected from extreme environmental conditions which may affect their ability to accurately record radiation. Film badges must be exchanged on a MONTHLY basis.

**C. Thermoluminescent Dosimeters (TLD)**

TLDs are personnel monitoring badges that contain small crystals capable of storing some of the energy from radiation. If the crystals are then heated to a specific temperature, they release the stored energy as light. The amount of light released is proportional to the amount of radiation the TLD badge received, which can be measured to determine the badge wearer's dose. TLDs should be protected from extreme environmental conditions which may affect their ability to accurately record radiation. They must be exchanged at least every THREE months.

**D. Optically Stimulated Luminescent Dosimeters (OSLDs)**

OSLDs measure radiation through a thin layer of aluminum oxide. A laser light stimulates the aluminum oxide after use, causing it to become luminescent in proportion to the amount of radiation exposure. OSLDs must be exchanged at least every THREE months.

**III. INSTRUCTIONS FOR USING PERSONNEL MONITORING DEVICES**

**A. General Instructions**

A whole body personnel monitoring badge (film, TLD or OSLD) will be worn at all times when handling, using, or transporting a portable nuclear gauge. Each Authorized User will be assigned a badge, which can only be worn by the individual to whom it has been assigned. Badges are to be worn on the front of the torso, at or above the waist and below the shoulder. Badges must be promptly returned to the Radiation Safety Officer (RSO) at the end of each monitoring period to ensure rapid processing.

**Recommended Work Practices for Personnel Monitoring**

- ◆ Never leave badges in close proximity to a gauge or other radiation source
- ◆ Protect badges from moisture, intense heat or light and chemicals
- ◆ When not in use, store badges with their control badge in a low background radiation area

**B. Special Instructions for New Hires and Lost/Damaged Badges**

To ensure accurate monitoring of occupational dose, an assigned badge will be ordered immediately for new gauge operators. A spare/visitor badge may be provided to new workers until the assigned badge arrives. Spare badges may also be used to replace a badge that has been lost or damaged before the end of the monitoring period. To ensure their use by only one individual, spare badges will be imprinted with the

worker's name or another form of identification. Workers assigned spare badges will have the dose recorded by the badge added to their occupational dose record. In the event of a lost/damaged badge, the RSO will estimate the worker's dose for the period the badge was worn, and must request approval from the Department to revise the individual's dosimetry record.

#### IV. **PERSONNEL MONITORING RECORDS REQUIREMENTS**

##### A. **Records of Prior Occupational Dose**

Prior to assigning a badge to a worker the worker's occupational radiation dose received during the current year will be determined. In addition, every reasonable effort must be made to obtain the individual's records indicating the individual's cumulative occupational radiation dose. If a worker is unable to provide the information, records from their previous employer will be obtained. Prior occupational dose records shall include all of the information required by the Rules and Regulations for Control of sources of Ionizing Radiation, Paragraph RH-2826, "Cumulative Occupational Exposure History", Department Form Z, or an equivalent form.

##### B. **Records of Individual Monitoring Results**

Records of doses received by each monitored worker will be maintained as long as the company's license remains in effect. Dosimetry records will be kept in accordance with the Rules and Regulations for Control of Sources of Ionizing Radiation, Paragraph RH-2804, "Notifications and Reports to Individuals" on Department Form Y, Paragraph RH-2825, or an equivalent form, and will contain all of the information required by Paragraph RH-2804. These records will be updated annually.

##### C. **Annual Reports to Monitored Individuals**

Each worker assigned a personnel monitoring badge will receive a written annual dose report describing the past year's monitoring results, as required by the Rules and Regulations for Control of sources of Ionizing Radiation, Paragraph RH-2804, "Notifications and Reports to Individuals". Records documenting that the reports have been furnished to monitored workers will be maintained for at least 3 years.

##### D. **Termination Reports to Monitored Individuals**

Within 30 days of termination of employment, or within 30 days after the individual's exposure has been determined, whichever is later, each monitored worker will receive a written report summarizing the individual's occupational radiation dose, as required by Rules and Regulations for Control of sources of Ionizing Radiation, Paragraph RH-2804, "Notifications and Reports to Individuals". Records documenting that the reports have been furnished to monitored workers will be maintained for at least 3 years.

##### E. **Records for Declared Pregnancies**

The fetal dose will be closely monitored so as not to exceed 500 millirem. Female gauge operators that have declared themselves pregnant will be instructed to always wear their assigned badge at waist level to estimate the embryo/fetus dose.



Recordkeeping requirements specified in the Rules and Regulations for Control of sources of Ionizing Radiation, Paragraph RH-1207, “Dose to an Embryo/Fetus” and RH-1500.f.5., “Records of Individual Monitoring Results”, will be met.

**F. Occupational Dose Limits for Minors**

Minors will not exceed an annual occupational dose of 500 millirem. Recordkeeping requirements specified in Rules and Regulations for Control of sources of Ionizing Radiation, Paragraph RH-1206, “Occupational Dose Limits for Minors” and Paragraph RH-2804, “Notifications and Reports to Individuals”, will be met.

**G. Worker Overexposure Reports**

When a report of an individual’s exposure is sent to the Arkansas Department of Health as required by Rules and Regulations for Control of sources of Ionizing Radiation, Paragraph RH-1505, “Notifications and Reports to Individuals”, the exposed individual will also be notified no later than when the report is sent out.

**Appendix F**

**Form F**

**PERSONNEL MONITORING PROGRAM**

**Describe the proposed personnel radiation dose monitoring program by marking the appropriate boxes. Submit the completed Form with the Application**

---

**1. Personnel Monitoring Device to be Used:**

- Film**                       **OSLD**                       **TLD**

**2. Radiation Detected:**

- Beta**                       **Gamma**                       **Neutron**

**3. Type Monitoring:**

- Whole body**                       **Extremity**

**4. Frequency of exchange:**

- Monthly**                       **Quarterly**

**5. Supplier of Personnel Monitoring Service: \_\_\_\_\_**

**Vendor Registration Number: \_\_\_\_\_**

- PERSONNEL MONITORING IS NOT REQUIRED BECAUSE THE PROJECTED PERSONNEL RADIATION DOSE IS CALCULATED TO BE LESS THAN 500 MILLIREM PER YEAR FOR EACH INDIVIDUAL.**

**Justification for this decision is provided in the completed Form F, Table 1.**

**Appendix F**  
**Attachment 1**

**Guidance for Demonstrating That Unmonitored Individuals Are Not Likely to Exceed 10 Percent of the Allowable Limits**

Personnel monitoring is required for individuals who are likely to receive a radiation dose of more than 10% of the annual dose limit permitted by the Rules and Regulations for Control of Sources of Ionizing Radiation, Paragraph RH-1200, "Occupational Dose Limits for Adults." The whole body radiation dose limit which requires personnel monitoring is 500 millirem per year or greater. However, if individuals are not expected to receive this dose, personnel monitoring may not be required.

To demonstrate that personnel monitoring devices are not required, the applicant must perform an evaluation to estimate the annual radiation dose to workers and must submit the evaluation with the Application. The applicant/licensee must also retain a copy of the evaluation for inspection purposes.

Common ways that individuals may exceed 10% of the applicable limits are by frequently using the gauge and by performing routine cleaning and lubrication of gauges. Thus, a licensee would must evaluate the radiation doses workers might receive in performing these tasks to determine if personnel monitoring is required.

Applicants who wish to demonstrate that they are not required to provide personnel monitoring must prepare a written evaluation that includes all potential pathways of radiation exposure (transport, field use, maintenance) similar to that shown in the following example. **The expected dose rates, times, and distances used in the example may not be appropriate to your situation.** In the evaluation, you must use information appropriate to your types of gauges that will be possessed and used. This type of information is generally available from the gauge manufacturers or the Sealed Source and Device Catalogue Registration Sheet maintained by the U.S. Nuclear Regulatory Commission and the Agreement States.

**Example**

One gauge manufacturer has estimated the doses to the whole body and the extremities of an individual performing routine cleaning and lubrication of one of its gauges. The gauge is authorized to contain up to 9 millicuries of Cesium-137 and 44 millicuries of Americium-241. The manufacturer based its estimate on observations of individuals performing the recommended procedure according to good radiation safety practices. The manufacturer determined the following types of information:

- Time needed to perform the entire procedure (e.g., 10 min)
- Expected dose rate received by the whole body of the individual, associated with the shielded source and determined using measured or manufacturer-determined data (e.g., 20 millirem per hour at contact with the shield)

- Time the hands were exposed to the unshielded source (e.g., 3 min)
- Expected dose rate received by the extremities of the individual associated with the unshielded source and determined using measured or manufacturer-determined data for the typical distance that the hands would be from the sealed source (e.g., 900 millirem per hour or 15 millirem per minute)

From this information, the manufacturer estimated that the individual performing each routine cleaning and lubrication could receive the following:

- Less than 4 millirem, dose to the whole body

<b>Calculation:</b> 10 min X 20 millirem/hour X 1 hour/60 minutes = 3.3 millirem
--

- 45 millirem, dose to the hands

<b>Calculation:</b> 3 minutes X 900 millirem/hour X 1 hour/60 minutes = 45 millirem
---

The applicable limit (whole body) is 5000 millirem per year and 10% of that value is 500 millirem per year. If one cleaning/lubrication results in 4 millirem, then an individual could perform 125 of these operations each year and remain within 10% of the applicable limit.

The applicable limit for the extremities is 50,000 millirem per year and 10% of that value is 5,000 millirem per year. If one cleaning/lubrication results in 45 millirem, then an individual could perform 111 of these operations each year and remain within 10% of the applicable limit. Based only on this specific situation, personnel monitoring may not be required.

However, using the same type of analysis, the applicant must also determine the radiation dose that the workers receive from the routine daily use of the gauge. Specifically, the evaluation must include the following:

- Removal of gauge from permanent storage and securing the gauge in the transport vehicle
- At the job-site, removal of the gauge from the vehicle and transporting the gauge to the work area
- Set up and use of the gauge at the work area (exposing the radiation source, taking measurements, etc.)
- Return the gauge to the vehicle and secure the gauge in the vehicle
- Return the gauge to the permanent storage at the end of the work day

Radiation survey data provided (by the Sealed Source and Device Catalogue Registration Sheet maintained by the U.S. Nuclear Regulatory Commission and the Agreement States) for a typical gauge includes the following:

1. Surface of the gauge in the closed or shielded position:

Bottom: 12 millirem per hour    Side: 14 millirem per hour    Top: 6 millirem per hour

Front: 21 millirem per hour    Back: 5 millirem per hour

2. Highest radiation level at 24" from a gauge in the closed or shielded position:  
0.3 millirem per hour
3. Highest radiation level at the surface of the shipping case with gauge for shipment:  
Top: 4 millirem per hour     Side: 3.5 millirem per hour
4. Radiation level to Operator with probe 8" in soil:  
Operator in stooped position at about 18" in back of gauge: About 1 millirem(0.65 millirem)  
Personnel in a position at about 36" front of gauge: About 1 millirem (1.25 millirem)

### **Guidance to Licensees**

Table 1, Personnel Dose Evaluation, may be helpful in preparing and documenting an Applicant's evaluation of the personnel monitoring program.

Licensees should review the evaluation periodically and revise it as needed. Licensees must check assumptions used in their evaluations to ensure that they continue to be up-to-date and accurate. For example, if workers become lax in following good radiation safety practices, in the example used above, the extremities could be closer to the unshielded source, and they would receive more than 15 mrem per minute. Alternatively, workers could perform the task more slowly than the estimated 10 minutes total and 3 minutes with the hands near the unshielded source. Also, the purchase of new gauges containing sources of different activities, different radionuclides, or different cleaning/lubrication procedures would require a new evaluation.

**Table 1**  
**Personnel Dose Evaluation**

Dosimetry Evaluation for \_\_\_\_\_ Portable Gauge, Model \_\_\_\_\_

**1. USING THE GAUGE**

NOTE: This estimate is for the Annual Whole Body dose and does not include the extremities (hands)
--

- Remove gauge from storage: Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem
  - Securing gauge in vehicle: Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem
  - Remove gauge from vehicle  
and transport to job-site Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem
  - Set up and use gauge Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr X  
Number of times gauge is used during work day \_\_\_\_\_ = Dose \_\_\_\_\_ millirem
  - Transport and secure gauge  
in vehicle Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem
  - Return gauge to storage Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem
- Add the Dose Column      Daily Dose \_\_\_\_\_ millirem

Number of days gauge used in a year by same individual \_\_\_\_\_ days /yr X Daily dose \_\_\_\_\_ millirem/day=

Annual Dose \_\_\_\_\_ millirem

**2. MAINTAINING THE GAUGE**

<b>NOTE: This estimate is for the Annual Whole Body dose and the Extremities (hands) dose</b>
---

- Remove gauge from storage

Whole Body Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem

- Perform the cleaning and lubrication procedure

Whole Body Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem

Extremity Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem

- Return gauge to storage

- Whole Body Time \_\_\_\_\_ hr X Dose Rate \_\_\_\_\_ millirem/hr = Dose \_\_\_\_\_ millirem

Add the Dose Column	<b>Whole Body Dose</b> _____ millirem
	<b>Extremity Dose</b> _____ millirem

Number of times the gauge is maintained by same individual \_\_\_\_\_ times/yr X Whole Body Dose \_\_\_\_\_ millirem =

**Annual Whole Body Dose** \_\_\_\_\_ millirem

Number of times the gauge is maintained by same individual \_\_\_\_\_ times/yr X Extremity Dose \_\_\_\_\_ millirem =

**Annual Extremity Dose** \_\_\_\_\_ millirem

**3. TOTAL ANNUAL ESTIMATED DOSE**

**Whole Body Dose**

Whole Body Dose due to Using the gauge \_\_\_\_\_ millirem

Whole Body Dose due to Maintaining the gauge \_\_\_\_\_ millirem

Add the Whole Body Dose

Total Annual Estimated Whole Body Dose \_\_\_\_\_ millirem

**Extremity Dose**

Extremity Dose due to Maintaining the gauge \_\_\_\_\_ millirem

Total Annual Estimated Extremity Dose \_\_\_\_\_ millirem

**4. REQUIREMENTS FOR PERSONNEL MONITORING**

Annual Whole Body Dose equal to or greater than **500** millirem requires personnel monitoring

Annual Extremity Dose equal to or greater than **5000** millirem requires personnel monitoring



# Appendix VII

## NOTICE TO EMPLOYEES

### Arkansas Department of Health STANDARDS FOR PROTECTION AGAINST RADIATION

The Arkansas Department of Health (ADH) has adopted regulations with standards to protect you from hazards associated with radioactive materials and radiation emitting machines which are licensed or registered by ADH. In particular, the following information is available for your review:

**Section 3:** Standards for Protection Against Radiation  
**Part N:** Notice, Instructions, and Reports to Workers; Inspections  
Any other documents your employer must provide.

These may be found at the following location:

#### YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to:

1. Comply with all applicable regulations and the conditions of the license or registration.
2. Post or otherwise make available to you a copy of the regulations, licenses, and operating procedures which apply to work in which you are engaged, and explain the provisions to you.

#### YOUR RESPONSIBILITY AS A WORKER

You should:

1. Know the provisions of the ADH regulations, the precautions, the operating procedures, and the emergency procedures which apply to your work.
2. Observe the provisions of your own protection and for the protection of your co-workers.
3. Report unsafe working conditions or violations of the license or registration conditions or regulations to ADH.

#### REPORTS OF YOUR RADIATION EXPOSURE HISTORY

1. The ADH regulations specify the occupational limits for radiation exposure including concentrations of radioactive material in air and water. These regulations require your employer to give you a written report if you receive exposure in excess of any applicable limit. The limits on your exposure are contained in RH-1200, RH-1206, and RH-1207. While these are the maximum allowable limits, your employer should keep your radiation exposure below those limits as is reasonably achievable.
2. If you work where personnel monitoring is required and request information on your radiation exposures,
  - a. your employer must advise you annually of your exposure to radiation, and
  - b. upon termination of employment, your employer must give you a written report of your radiation exposures.
  - c. A report of any exposure in excess of a limit must be reported to you.

**INSPECTIONS:** All licensed or registered activities are subject to inspection by the ADH.

#### INQUIRIES

Direct all inquiries on matters outlined above to: ADH, Radiation Control Section, 4815 West Markham Street, Mail Slot 30, Little Rock, Arkansas 72205-3867 or to (501) 661-2301. For emergencies, call (800) 633-1735.

**POSTING REQUIREMENT:** In accordance with RH-2802, copies of this notice must be posted in every establishment where employees are engaged in activities licensed or registered by the ADH. Posting must permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

Appendix I to Section 3  
Form X

Revised 10/01/12

## APPENDIX VIII

### MATERIAL LICENSED FOR USE AT

### ARKANSAS STATE UNIVERSITY

<b>Radioactive Material (Element and Mass Number)</b>	<b>Chemical and/or Physical form</b>	<b>Maximum Radioactivity and/or quantity of material which licensee may possess at any one time.</b>
A. Radioactive Material between Atomic Numbers 3 and 83	A. Any	A. Not to exceed 50millicuries per radionuclide,excluding items below.
B. Americium-241-Beryllium	B. Sealed Source (Troxler Electronics Dwg.No. A-102451)	B. 44 millicuries
C. Americium-241	C. Monsanto MCR-A-SS-U-AM type source	C. 5 microcuries
D. Americium-241	D. Isotope Products AF-241	D. 0.1 microcuries
E. Cs-137	E. Sealed source (Troxler electronics Dwg. No. A-102112)	E. 9 millicuries
F. Hydrogen-3	F. Any	F. 50 millicuries total
G. Neptunium-237	G. Any	G. 5 millicuries total
H. Plutonium-238	H. Any	H. 0.1 millicuries total
I. Plutonium-239	I. Any	I. 0.1 millicuries total
J. Plutonium-239	J. Sealed Source (Monsanto MCR-N-SS-W-Pu-Be)	J. 32 grams encapsulated as a 2 curie Pu-Be neutron source.
K. Radium-226	K. Sealed Sources in liquid scintillation counters.	K. 1 millicuries total
L. Thorium-228	L. Any	L. 5 millicuries total
M. Thorium-232	M. Any	M. 20 kilograms total

N. Depleted Uranium	N. Any	N. 5 kilograms total
O. Uranium	O. Natural	O. 20 kilograms total
P. Uranium-232	P. Any	P. 5 millicuries total
Q. Uranium-233	Q. Any	Q. 2 grams total

# APPENDIX IX

## GUIDELINES FOR BIO-ASSAYS

### **PART I**

Conditions under which bioassays may be necessary for the use of Iodine-125 and Iodine-131:

1. When an individual handles in open form unsealed quantities of radioactive iodine that exceed those shown in Table 1 below. The quantities shown in Table 1 apply to both the quantity handled at any one time or integrated as the total amount of activity introduced into a process by an employee over any 3-month period.
2. When quantities handled in unsealed form are greater than 10% of Table 1 values, routine bioassay may still be necessary under certain circumstances. A written justification for not performing such measurements should be prepared and recorded whenever bioassay is not performed and the quantities handled exceed 10% of the levels in Table 1.
3. Bioassay is generally not required when process quantities handled by a worker are less than 10% of those in Table 1.

Types of bioassays that should be performed are:

1. **Baseline:** Prior to beginning work with radioactive iodine in sufficient quantity that bioassay is specified in Item 1 above.
2. **Routine:** At the frequency specified.
3. **Emergency:** As soon as possible after any incident that might cause thyroid uptakes to exceed burdens given below, so that recommended actions can be most effective.

Show in the application that the need for bioassays has been thoroughly considered and that the proposed bioassay program is appropriate for the intended use of radioactive material.

Submit procedures for bioassays that address at least the following:

1. Frequency of testing.
2. Methods used for testing (e.g., thyroid scan, urinalysis), including a description of the procedures involved.
3. Determination of baseline values on individuals involved.
4. Instrumentation used.
5. Provisions for monitoring excretion of radioactive material in any individual who shows radionuclide uptake.
6. Action levels for the tests and the corrective action to be taken when these levels are exceeded. Recommended action levels for thyroid burden at the time of measurement is 0.12 microcurie of I-125 and 0.04 microcurie of I-131.

NOTE: Guidance on bioassay program for I-125 and I-131 is provided in NRC Regulatory Guide 8.20. If bioassays are not considered appropriate for the proposed program, specify the reasons for this conclusion.

TABLE 1

ACTIVITY LEVELS ABOVE WHICH BIOASSAY FOR I-125 OR I-131 IS NECESSARY

ACTIVITY HANDLED IN UNSEALED FORM

MAKING BIOASSAY NECESSARY

TYPES OF OPERATION	VOLATILE OR DISPERSIBLE	BOUND TO NONVOLATILE AGENT
--------------------	-------------------------	----------------------------

Processes in open room or bench, with possible escape of iodine from process vessels.	1 mCi	10 mCi
Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability	10 mCi	100 mCi
Processes carried out within glove boxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage.	100 mCi	1000 mCi

**PART II** Additional information for Use of Tritium (Hydrogen –3)

I. **Special Surveys**

A. Airborne Tritium

If Tritium is requested in sufficient quantity and form as to be airborne, air monitoring for Tritium may be necessary. Describe the procedures and equipment used to perform this monitoring, including appropriate action levels. Specific regulatory requirements for airborne radioactive material concentrations in restricted areas are contained in Paragraph RH-1201 of the Arkansas Board of Health’s Rules and Regulations for Control of Sources of Ionizing Radiation.

B. Contamination Surveys

Since Tritium tends to be a persistent and pervasive contamination problem, a rigorous program for conducting wipe surveys (smears) of Tritium use and storage areas should be implemented. Wipes should be taken of any surface that may have been contaminated on at least a weekly basis. Action levels for these surveys should be no higher than 200 dpm/100 cm. Describe the procedures and equipment involved in performing wipe surveys of Tritium use and storage area, including frequency, action levels, materials involved and the person responsible for conducting surveys.

II. **Handling of Contaminated Material**

Some materials, which may become contaminated by Tritium during routine operations, include soil, building materials and transformer and lubricating oils in particle accelerators with Tritium targets. Describe the procedures used to decontaminate and/or dispose of material that has been contaminated. Also, describe the control procedures that will be implemented to reduce the possibility of Tritium contamination.

### III. Bioassays

Bioassays may be required for persons working with millicuries (or higher) quantities of Tritium. Submit procedures for Tritium bioassay, which address at least the following:

1. Frequency of testing.
2. Method of testing (e.g., urinalysis) including a description of the specific procedures involved.
3. Determination of baseline values on individuals involved.
4. Instrumentation used.
5. Action levels for bioassays.
6. Corrective actions to be taken when action levels are exceeded, including provisions for monitoring excretion of Tritium or for retesting of individuals which show uptake.
7. A bioassay should be performed within one month of the last possible exposure to Tritium, when operations are being discontinued, or when the worker is terminating activities with potential exposure.

Routine bioassay is necessary when quantities processed by an individual at any one time or the total amount processed per month exceed those for the forms of Tritium shown in Table 2.

Under certain circumstances, routine bioassay may still be necessary when quantities are less than the levels in Table 2 but more than 10% of those levels. A written justification for not performing bioassays should be presented in these cases.

Special bioassay measurements may be needed to verify the effectiveness of respiratory protective devices or protective clothing used to prevent inhalation or absorption of Tritium. These special bioassays should be performed to determine the actual Tritium intake of an individual wearing a respiratory protective device or protective clothing if the concentration of Tritium (in any form) in the air is such that exposure for 40 hours per week for 12 weeks to the uniform concentration of Tritium in air specified in Table 1, Column 1, of Paragraph RH-2200, Appendix A. Special bioassay procedures should also be conducted for personnel wearing respirators if, for

any reason, the average Tritium concentration in air and the duration of exposure are unknown or can not be conservatively estimated by calculation.

Bioassays should be performed when air monitoring indicates exposures may exceed 25% of the quarterly limit on intake (inhalation plus absorption) in Paragraph RH-1201 (a)(1). This 25% value should be taken to be 1.6 millicuries. \*

Multiplying the concentration given in RH-2200,  $5 \times 10^{-6}$   $\mu\text{Ci/ml}$ , by  $6.3 \times 10^8$  ml gives the corresponding quarterly intake of Tritium by inhalation. In the case of inhaled HTO, which mixes instantly with other water molecules after entering body fluids, the intake may be assumed equal to the uptake. The uptake of Tritium (as HTO) by absorption through the skin is assumed equal to the uptake by inhalation unless the form of Tritium in the air can be demonstrated to have lower uptakes. The total uptake, including skin absorption, would be assumed to be about 6.3 mCi, which delivers a dose commitment of about 1.25 rems to standard man (using  $Q = 1.7$ ). A 40-hour occupational exposure at a concentration of  $5 \times 10^{-6}$   $\mu\text{Ci/ml}$  would thus result in an intake of  $6.3/13=0.48$  mCi and a dose commitment of about 0.1 rem. An acute intake (in less than one day) of 0.48 mCi would result in an initial body water concentration of about 11  $\mu\text{Ci/liter}$ .

## **TRITIUM BIOASSAY FREQUENCY GUIDELINES**

### **Initial Routine**

A bioassay sample of at least 100 ml of urine should be taken within 72 hours following entry of an individual into an area where operations require bioassay according to the criteria in this guide and then every two weeks or more frequently thereafter as long as the individual is working with Tritium. When work with Tritium is on an infrequent basis (less frequently than every two weeks), bioassay should be performed within 10 days of the end of the work period during which Tritium was handled.

### **After Three Months**

A sampling frequency selected in accordance with the above paragraph may be changed to quarterly if, after three months, the following three conditions are met:

- A. The average urinary Tritium concentration from specimens obtained during the 3-month period does not exceed 3  $\mu\text{Ci/L}$ ,
- B. If measurements of the concentration of Tritium in air are required as a condition of the license, the quarterly average concentration ( $\mu\text{Ci/ml}$ ) to which the workers are exposed multiplied by the factor  $6.3 \times 10^8$  ml does not exceed 0.8 mCi, and



- C. The working conditions during the 3 month period, with respect to the potential for Tritium exposure, are representative of working conditions during the period in which a quarterly urinalysis frequency is employed, and there is no reasonable expectation that the criteria given in items a and b above will be exceeded.

### **After Use of Respiratory Protective Devices or Protective Suits**

A bioassay sample should be taken within 72 hours after respiratory protective devices; suits, hoods or gloves are used to limit exposure as stated in this guide.

## **TRITIUM BIOASSAY ACTION LEVEL AND CORRESPONDING ACTION GUIDELINES**

### **Biweekly or More Frequent Sampling**

- A. Whenever the intake of Tritium within any 40-hour work period exceeds the amount that would be taken into the body from uniform exposure for 40 hours at the air concentration ( $5 \times 10^{-6}$   $\mu\text{Ci/ml}$ ) specified in Table 1, Column 1 of Appendix A, paragraph RH-2200, the licensee is required to make evaluations, take necessary corrective actions and maintain records by Paragraph RH-1201 (b) (2).
- B. If urinary excretion rates exceed 5  $\mu\text{Ci/L}$  but are less than 50  $\mu\text{Ci/L}$ , the following course of action should be taken:
1. A survey of the operations involved, including air and surface contamination monitoring, should be carried out to determine the causes of the exposure and evaluate the potential for further larger exposures or for the possible involvement of other employees.
  2. Any reasonable corrective actions that the survey indicates may lower the potential for further exposures should be implemented.
  3. A repeat urine sample should be taken within one week of the previous sample and should be evaluated within a week after collection. Internal dose commitments should be estimated using at least these two urine sample evaluations and other survey data, including the probable times of the intake of Tritium.
  4. Any evidence indicating that further work in the area might result in an employee receiving a dose commitment in excess of the limits established in RH-1200 should serve as cause to remove the employee from work in the operation until the source of exposure is discovered and corrected.
  5. Reports or notification must be provided as required by RH-1504 and RH-2804, or as required by conditions of the license pursuant to RH-1205.
- C. If urinary excretion rates exceed 50  $\mu\text{Ci/L}$ , the following course of action should be taken:
1. Carry out all steps in Item above.

2. If the projected dose commitment exceeds levels for whole body as provided in RH-1502, provide appropriate notification to the Department.
3. Refer the case to appropriate medical/health physics consultations for recommendations regarding immediate therapeutic procedures that may be carried out to accelerate removal of Tritium from the body and reduce the dose to as low as is reasonably achievable.
4. Carry out repeated sampling (urine collections of at least 100 ml each) at approximately one-week intervals at least until samples show an excretion rate less than 5  $\mu\text{Ci/L}$ . If there is a possibility of long-term organic compartments of Tritium that require evaluation, continue sampling as long as necessary to ensure that appreciable exposures to these other compartments do not go undetected and to provide estimates of total dose commitments.

### **Quarterly Sampling**

Carry out the actions called for when any of the levels indicated in the above paragraphs are exceeded. In addition, reinstitute biweekly (or more frequent) sampling for at least the next 6-month period, even when urinary excretion falls below 5  $\mu\text{Ci/L}$ .

*This page is maintained by [Starr Fenner](#) and was last updated 9 July 2012*

---

Page intentionally left blank