

# CHEMICAL HYGIENE, LABORATORY EQUIPMENT, AND BIOLOGICAL FACILITY SAFETY PLAN

College of Integrated Science and Technology  
&  
School of Engineering

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# TABLE OF CONTENTS

<b><u>SECTION</u></b>	<b><u>PAGE</u></b>
I AUTHORSHIP AND PURPOSE	1
II GOVERNMENTAL REGULATION	2
III SCOPE OF CONTENT AND APPLICATION	6
IV RESPONSIBILITIES	
• DEAN OF THE COLLEGE	9
• DIRECTOR OF THE SCHOOL OF ENGINEERING	9
• ASSISTANT DEAN OF THE COLLEGE AND LABORATORY DIRECTOR	9
• SAFETY/CHEMICAL HYGIENE OFFICER	9
• FACULTY MEMBERS/LABORATORY SUPERVISORS/LAB- ORATORY INSTRUCTORS/PROJECT DIRECTORS & RESEARCH ADVISORS	9
• LABORATORY WORKERS AND STUDENTS	10
• UNIVERSITY ENVIRONMENTAL HEALTH COORDINATOR	10
V EMPLOYEE/STUDENT INFORMATION AND TRAINING	11
• SOURCES OF INFORMATION	
○ AVAILABILITY OF THIS SAFETY DOCUMENT	11
○ AVAILABILITY OF OSHA PELs, NIOSH RELs AND IDLHs PERTAINING TO CHEMICAL EXPOSURES, AVAILABLE INFORMATION PERTAINING TO POTENTIALLY HAZARDOUS APPARATUS/ EQUIPMENT	11
○ AVAILABILITY OF MSDSs AND OTHER DOCUMENTS PROVIDING INFORMATION FOR SAFE HANDLING OF CHEMICALS AND DISPOSAL OF CHEMICALS AND CHEMICAL WASTE	11
○ LOCATION OF DOCUMENTS PERTAINING TO BIOLOGICAL HAZARDS, THEIR SAFE HANDLING, AND THEIR DISPOSAL	11
• ACCEPTABLE WORK PRACTICES	11
• EMERGENCY RESPONSE	12

	• HEALTH/MEDICAL ISSUES	12
	○ ACUTE AND CHRONIC EXPOSURES TO CHEMICALS	12
	○ EXPOSURE TO POSSIBLY HARMFUL BIOLOGICAL AGENTS	12
	○ OPPORTUNITIES FOR MEDICAL CONSULTATION, EVALUATION, AND TREATMENT	13
	• TRAINING OF LABORATORY PERSONNEL (FACULTY, STAFF, STUDENTS)	13
	○ PROVIDERS OF TRAINING	13
	○ TIMES OF INITIAL TRAINING AND REFRESHER TRAINING SESSIONS	13
	○ PERSONS TO RECEIVE APPROPRIATE TRAINING	13
	○ LABORATORY SAFETY RULES (GENERAL, CHEMICAL/BIOCHEMICAL, EQUIPMENT/INSTRUMENTATION LABORATORIES)	13
VI	STANDARD OPERATING PROCEDURES TO ENSURE CHEMICAL/BIOCHEMICAL AND BIOLOGICAL SAFETY	19
	• CHEMICAL/BIOCHEMICAL/BIOLOGICAL AGENT PROCUREMENT, DISTRIBUTION, AND STORAGE	19
	• CLASSES OF HAZARDOUS CHEMICALS/BIOCHEMICALS	
	○ COMBUSTIBLES AND FLAMMABLES	21
	○ CORROSIVES/IRRITANTS	21
	○ REPRODUCTIVE TOXINS, HIGH ACUTE TOXICITY AGENTS AND SELECT CARCINOGENS	22
	○ COMPRESSED GASES, LIQUEFIED GASES, AND CRYOGENIC LIQUIDS	22
	• HAZARDOUS (OR POTENTIALLY HAZARDOUS) BIOLOGICAL AGENTS (BACTERIAL PATHOGENS, ANIMAL VIRUSES, CULTURED MAMMALIAN CELLS) IN A BIOSAFETY LEVEL 2 ENVIRONMENT	23
	• CONTROL MEASURES AND EQUIPMENT	23
	○ LABORATORY VENTILATION	23
	○ CHEMICAL FUME HOODS	23
	○ BIOLOGICAL SAFETY CABINETS	24
	○ SAFETY EQUIPMENT	24
	○ PERSONAL PROTECTIVE EQUIPMENT (PPE)	25
	• CHEMICAL AND BIOLOGICAL HAZARD IDENTIFICATION	25
	• CHEMICAL AND BIOLOGICAL WASTE DISPOSAL	32
	• INSTRUMENT/EQUIPMENT SAFETY	32
	• RECORDS	35
VII	BLOODBORNE PATHOGEN CONTROL PROGRAM	36
VIII	FACULTY/STUDENT PROJECTS REQUIRING APPROVAL	39
IX	REFERENCES	40

**APPENDICES**

**PAGE**

ALRT Form

A1

ALRT-C Form

A2

Example 'Laboratory Specific Safety Policy Document'

A3

## I. AUTHORSHIP AND PURPOSE

This document was composed as an adaptation of a plan originally written for the particular needs of the Integrated Science and Technology Program. In the Fall of 2008, changes in the document were made so that it applied to any science and/or manufacturing/engineering laboratory of the College of Integrated Science and Technology and the newly established School of Engineering (SOE). Authored by George L. Coffman (former CISAT Chemical Hygiene and Safety Officer), the CISAT/SOE *Chemical Hygiene, Laboratory Equipment, and Biological Facility Safety Plan* is the property of the College of Integrated Science and Technology and the School of Engineering, James Madison University.

The purpose of this document is to establish procedures used, personal protective equipment required (or recommended), and work practices to be followed that will protect employees, students, and visitors to CISAT/SOE laboratories from health risks presented by potentially hazardous chemicals and biological agents, as well as injury from equipment if used without appropriate regard to safety. *All laboratory workers—faculty, staff and students of CISAT/SOE, as well as visitors to any CISAT/SOE laboratory —should be given ready access to this plan.*

## II. GOVERNMENTAL REGULATION

The CISAT/SOE Chemical *Hygiene, Laboratory Equipment, and Biological Facility Safety Plan* was written to comply with these *United States Department of Labor (Occupational Safety & Health Administration) Regulations (Standards—29 CFR)*:

### Part 1910 (OCCUPATIONAL SAFETY AND HEALTH STANDARDS)

#### Subpart A—General

##### 1910.9—Compliance duties owed to each employee

**Subpart I—Personal Protective Equipment** (deemed commensurate with hazards associated with laboratory chemicals, instrumentation and equipment, e.g., safety glasses, face shields, gloves, foot protection)

#### Subpart K—Medical and First Aid

##### 1910.151 Medical services and first aid (with **Appendix A**)

**Subpart O—Machinery and Machine Guarding** (as applied to, but not limited to, manufacturing laboratories and machine shops)

**Subpart P—Hand and Portable Powered Tools and Other Hand-Held Equipment** (as applied to, but not limited to, machine shops and engineering laboratories)

**Subpart S—Electrical** (as applied to, but not limited to, machine shops, engineering and instrumentation laboratories)

##### 1910.331 Scope

##### 1910.332 Training

##### 1910.333 Selection and use of work practices

##### 1910.334 Use of equipment

##### 1910.335 Safeguards for personal protection

**Subpart Z—Toxic and Hazardous Substances**

##### 1910.1030 Bloodborne pathogens

(with **Appendix A**)

1910.1096 Ionizing radiation (as applied to, but not limited to, laboratories having X-ray devices, and facilities in which certain chemicals [e.g., uranyl acetate] are used and require disposal as hazardous chemical waste)

##### 1910.1200 Hazard communication

(with **Appendices A, B, and E**)

**1910.1450 Occupational exposure to hazardous chemicals in laboratories**  
(with **Appendices A and B**)

Because of the diversity of teaching and research laboratory facilities within CISAT and the SOE, additional OSHA publications are cited in this document to address safety issues pertaining to these topics:

**Robotics Standards**

<http://www.osha.gov/SLTC/robotics/standards.html>

Numerous references to standards within CFR 1910 are cited on this webpage, several of which are already noted above. In addition, an OSHA Directive entitled *Guidelines for Robotics Safety (STD 01-12-002 [PUB 8-1.3])*—(especially **Appendix A-4 Guarding methods**)—is cited in this safety document.

**Laser Hazards Standards**

<http://www.osha.gov/SLTC/laserhazards/standards.html>

A reference to standards that pertain to personal protective equipment (for shielding the eyes and face) is cited on this webpage. Also, an OSHA directive entitled *Guidelines for Laser Safety and Hazard Assessment (STD 01-05-001 [PUB 8-1.7])* is cited in this safety document.

An additional source for this document—addressing both chemical and equipment safety—was *Prudent Practices for Handling Hazardous Chemicals in Laboratories: Handling and Disposal of Chemicals*, published by the National Research Council (1995). An earlier (1981) publication of *Prudent Practices* was cited in the OSHA Laboratory Standard, specifically in Appendix A of Standard 29 CFR 1910.1450, because of “its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council.”

**The OSHA Hazard Communication Standard (OSHA Standard 29 CFR 1910.1200) requires employers with hazardous chemicals in the workplace to provide information about those chemicals and safety training for their employees. Pertinent safety information will be provided to any outside contractors performing work in, and other visitors to, any CISAT/SOE chemical/biochemical, environmental, biosystems/biomanufacturing, analytical, anatomy/physiology, communication science and disorders, human performance, kinesiology, nursing, dietetics, occupational therapy, energy, materials/manufacturing/engineering, instrumentation, psychology/graduate psychology, and animal research laboratory.**

United States federal government agencies, such as the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH), offer information and guidelines pertaining to the design and safe operation of laboratories and facilities in which microbial agents (both non-pathogenic and pathogenic) and cultured mammalian cells are used, and in which recombinant DNA work is performed.

- Biosafety Levels 1, 2, and 3 are presented and explained in a CDC publication:

<http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm>

- The CDC Office of Health and Safety offers biosafety information, ‘biosecurity’ training, and various guidelines:

<http://www.cdc.gov/OD/ohs/biosfty/biosfty.htm> .

In that document is a hyperlink to the latest edition of the *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*:

<http://www.cdc.gov/OD/ohs/biosfty/bmb15/bmb15toc.htm> .

- “The National Institutes of Health (NIH) Office of Biotechnology Activities (OBA) promotes science, safety, and ethics in biotechnology through advancement of knowledge, enhancement of public understanding, and development of sound public policies. OBA accomplishes its mission through analysis, deliberation, and communication of scientific, medical, ethical, legal, and social issues.” Its website:

<http://www4.od.nih.gov/oba/> .

The ‘Recombinant DNA (RAC)’ hyperlink

<http://oba.od.nih.gov/rdna/rdna.html>

leads to a page on which links are given for the 1) NIH guidelines for recombinant DNA research, 2) facility/laboratory expectations are listed,

[http://oba.od.nih.gov/rdna/nih\\_guidelines\\_oba.html](http://oba.od.nih.gov/rdna/nih_guidelines_oba.html)

and the Institutional Biosafety Committee entity is described

[http://oba.od.nih.gov/rdna\\_ibc/ibc.html](http://oba.od.nih.gov/rdna_ibc/ibc.html) .

(The World Health Organization provides information about several microbiological agents and diseases they cause:

<http://www.who.int/csr/resources/publications/csrrpublications/en/index2.html> .

On that page is a hyperlink to a publication entitled *Laboratory Safety Manual, 3<sup>rd</sup> Edition*:

[http://www.who.int/csr/resources/publications/biosafety/WHO\\_CDS\\_CSR\\_LYO\\_2004\\_11/en/index.html](http://www.who.int/csr/resources/publications/biosafety/WHO_CDS_CSR_LYO_2004_11/en/index.html) .)

### III. SCOPE OF CONTENT AND APPLICATION

As recommended by *Prudent Practices for Handling Hazardous Chemicals in Laboratories: Handling and Disposal of Chemicals*, a the CISAT/SOE *Chemical Hygiene, Laboratory Equipment, and Biological Facility Safety Plan* contains these elements:

- employee information and training about the hazards of chemicals in the work area, including how to detect their presence or release, work practices and how to use protective equipment, and emergency response procedures;
- the circumstances under which a particular laboratory operation requires prior approval from the employer (administrator, director, manager);
- standard operating procedures for work with hazardous chemicals;
- criteria for use of control measures, such as engineering controls or personal protection equipment;
- measures to ensure proper operation of fume hoods and other protective equipment;
- provisions for additional employee protection for work with “select carcinogens” (as defined below) and for reproductive toxins or substances that have a high degree of acute toxicity;
- provisions for medical consultations and examinations for employees; and,
- designation of a chemical hygiene officer.

In addition, this document contains safety information regarding **laboratory equipment** found commonly in chemical, biochemical, anatomy, physiology, and microbiological laboratories, as well as information pertaining to laboratories containing **electrical/electronics apparatus, robotics and machining equipment, medical and health assessment apparatus, lasers, and materials development and processing.**

*This plan applies to all JMU CISAT/SOE employees and students, as well as onsite outside contractors and visitors—all persons whose work or activities within a CISAT/SOE laboratory may expose them to physical, chemical/biochemical, and biological hazards.*

**The regulations and policies outlined in this document apply to these CISAT/SOE and Department of Biology facilities:**

#### CISAT

##### **Integrated Science and Technology**

ISAT/CS 130, 134, 138 Biomanufacturing Laboratories  
ISAT/CS 146 Manufacturing Laboratory  
ISAT/CS 230, 234, 240 Environmental Laboratories  
ISAT/CS 242 Analytical Laboratory  
ISAT/CS 330, 334, 340 Biosystems Laboratories  
ISAT/CS 346 Energy Laboratory  
ISAT/CS 351 Laser and Optics Laboratory

HHS 0001 Manufacturing High Bay Laboratory  
HHS 0002 Energy High Bay Laboratory  
HHS 0004 Electron Microscopy Laboratory Suite  
HHS 0102 Electronics Shop  
HHS 0107 Machine Shop  
HHS 1027 Materials Processing Laboratory  
HHS 1031 Materials Characterization Laboratory  
HHS 2034 Clean Room Suite  
HHS 3021 Instrumentation Laboratory  
JMU Alternative Fuel Vehicle Facility (South Main Street)

## **Nutrition**

HHS 0008 Quantity Foods Laboratory  
HHS 0009 Nutrition Laboratory  
HHS 0119 and HHS 0120 Sensory Evaluation Laboratories

## **Communication Sciences and Disorders**

HHS 0109 Animal Facility  
HHS 0115 VG-VRT Laboratory  
HHS 1016 Auditory Research Laboratory  
HHS 1018 Psychoacoustic Research Laboratory  
HHS 1019 Applied Audiology Laboratory  
HHS 1024 Speech Research Laboratory

## **Nursing (and Physician's Assistant Program)**

HHS 2002 Skills Demonstration Laboratory  
HHS 2007 Nursing Satellite Lab  
HHS 2009 Skills Laboratory  
HHS 2018 Health Assessment Laboratory

## **Occupational Therapy Program**

HHS 2039 Complementary Therapies Laboratory  
HHS 3028 Functional Development Laboratory

## **Human Performance**

HHS 3009 Human Performance Laboratory

## **Kinesiology**

Godwin Hall laboratories

## **Psychology and Graduate Psychology**

Miller G060 – G074 Animal/Neuroscience Facility/Laboratories

## **School of Engineering**

HHS 2039 Engineering Machine Shop

## **Department of Biology facilities under CISAT Safety Regulations**

HHS 3008 Gross Anatomy Laboratory  
Driver Drive Modular #3 Anatomy Laboratory  
HHS 3010 Physiology Laboratory

## **IV. RESPONSIBILITIES**

### **Dean of the College of Integrated Science and Technology (CISAT)**

- ◇ Oversees and administers all aspects of the College of Integrated Science and Technology

### **Director of the School of Engineering**

- ◇ Oversees and administers all aspects of the School of Engineering

### **CISAT/SOE Director of Laboratory Services**

- ◇ Oversees the activities of the Chemical Hygiene and Safety Officer, and provides continuing support for CISAT and SOE laboratory chemical hygiene , biological, and equipment safety.

### **CISAT/SOE Chemical Hygiene and Safety Officer**

- ◇ Works with administrators and other employees, as well as students, to develop and implement appropriate chemical hygiene policies and practices
- ◇ Monitors procurement, use, and disposal of chemicals used in CISAT/SOE laboratories
- ◇ Helps faculty and students develop precautions and adequate facilities for work to be done in all science/engineering laboratories
- ◇ Informs students, faculty and staff, as well as the CISAT Laboratory Director and, if appropriate, the University Environmental Health Coordinator, of safety infractions and other laboratory chemical and equipment problems
- ◇ Seeks ways continually to improve and update this safety document

### **Faculty Members/Laboratory Supervisors/Laboratory Instructors/Project Directors and Research Advisers**

- ◇ Responsible for chemical hygiene and safety in the particular laboratory under his/her jurisdiction at a particular time. Such times include

- meetings of formal laboratory classes
  - instructional sessions for lab supervisors and instructors
  - lab exercise set-up periods
  - faculty-student research sessions
- ◇ Ensure that laboratory workers know and follow the chemical, biological and equipment safety rules; that personal protective equipment is available and is in working order; and that appropriate training has been provided
- Determine the required levels of protective apparel and equipment by personnel occupying a laboratory at any time, and ensure sufficient protective apparel and equipment used are commensurate with any recognized hazards
  - Ensures that the facilities for, and proper training needed for, the use of hazardous equipment and materials being used in the laboratory, are adequate

### **Laboratory Workers and Students**

- ◇ Are responsible for planning and conducting all operations in accordance with this safety document, as directed by those persons in charge of the laboratory
- ◇ Develop good personal chemical hygiene and safety habits as stated in this manual and in science/engineering laboratory safety documents provided as part of course syllabi

### **University Environmental Health Coordinator**

- ◇ Develops policies and procedures and methods to ensure safe handling of hazardous materials and chemicals on campus through a comprehensive safety program administered through Risk Management
- ◇ Ensures safe laboratory operations by university personnel through education and the inspection process
- ◇ Is responsible for the development and administration of lab safety, fume hood, safety shower, and other 'hazmat' programs for the university
- ◇ Interprets regulations, develops and implements programs and means of promotion/enforcement of university safety and environmental health policy

## V. EMPLOYEE/STUDENT INFORMATION AND TRAINING

**Sources of Information:** Each laboratory instructor/supervisor or research adviser is responsible for ensuring that this information is communicated to his/her employees and students under his/her direction:

(1) The *location and availability* of this safety document

(2) Sources of safety information about

- chemicals used in his/her laboratory or facility, including OSHA ‘Permissible Exposure Limits’ (OSHA PELs and other information for select chemicals), NIOSH (National Institute for Occupational Safety and Health) ‘Recommended Exposure Limits’ (NIOSH RELs), NIOSH ‘Immediate Dangerous to Life and Health’ values (NIOSH IDLHs)

<http://www.osha.gov/SLTC/pel/recognition.html>

[http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9992](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992)

[http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9993](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9993)

[http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9994](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9994)

<http://www.cdc.gov/niosh/npg/>

<http://www.cdc.gov/niosh/idlh/intridl4.html>

- potentially hazardous apparatus/equipment, e.g., safety information provided by the manufacturer or contained in government documents

<http://www.osha.gov>

(3) Material Safety Data Sheets (MSDSs), *vendor-specific*, for all chemicals in his/her laboratory

(4) Information pertaining to biological agents (both their laboratory use and their disposal) that are deemed hazardous or potentially hazardous, e.g., safety documents provided by the instructor/supervisor or research supervisor, CISAT/SOE Safety Officer, or offered in government documents

<http://www.cdc.gov>

### Acceptable Work Practices:

For each laboratory, a ‘Lab/Facility-Specific Safety Policy’ sheet is to be posted on a wall or a door. Issues pertinent to that lab or facility, such as

- the requirements for PPE (e.g., eye protection, gloves, footwear),
- the prohibition of food and drink,
- any unique physical, chemical, or biological hazards that require special attention and/or a more rigorous demand for chemical hygiene or safe work with biological agents,
- any modifications of, or enhancements to, those policies stated in this safety document for that particular laboratory for a particular chemical, biological agent, or piece of equipment or instrument that poses a potential hazard, and
- contact information (emergency and names of responsible personnel, their telephone numbers and electronic mail addresses)

are outlined in a single page readable format.

### **Emergency Response:**

Campus police should be contacted by telephone (extension 86911). Someone in that office will call off-campus agencies or services, as appropriate to the nature of the emergency.

General ‘first-aid’ steps to take in case of exposure to potentially hazardous chemical agents, such as **combustibles and flammables, corrosives/irritants, or reproductive toxins, high acute toxicity chemicals, and select carcinogens**, while awaiting medical attention:

- Remove any clothing saturated with spilled chemicals
- Wash affected skin areas with soap and water and flush for at least 15 minutes
- Flush eyes with water at an eyewash station for at least 15 minutes
- For severe exposures due to inhalation, remove victim to fresh air, keep warm and still
- For ingestion, keep victim warm
- **IN ALL CASES, CHECK THE MSDS FOR THE CHEMICAL (IF KNOWN) FOR MORE SPECIFIC FIRST-AID INFORMATION**

If an emergency situation arises that is believe to be associated with a person’s working with a potentially hazardous biological agent, information about that agent and the nature of the work performed in that laboratory should be communicated to the emergency responder.

### **Health/Medical Issues**

For information pertaining to **acute** exposures to chemical agents, consult the MSDS for that chemical. Information about **chronic** exposure can be found on the OSHA, CDC and NIOSH websites noted under the ‘Sources of Information’ heading of this section (above).

Information pertaining to biological agents used in a CISAT/SOE laboratory that pose a possible safety threat may be found on OSHA and CDC websites noted under the ‘Sources of Information’ heading of this section (above).

Medical consultation, evaluation, and any treatment deemed appropriate will be available through the campus health center or from Rockingham Memorial Hospital.

**Training:** Each laboratory instructor/supervisor or research adviser is responsible for ensuring that laboratory employees, e.g., student laboratory assistants, state-classified full time employees, part-time CISAT/SOE employees, receive adequate training. This training should include

- 1) Any physical and health hazards of chemicals, biological agents, and equipment located in the work area;
- 2) The measures employees and students can take to protect themselves from such hazards, including specific procedures that have been implemented to protect laboratory employees from exposure to hazardous chemicals, biological agents, and potentially dangerous equipment (e.g., appropriate work practices, personal protective equipment to be used, and emergency response procedures); and
- 3) Applicable details of this safety document.

Information and training that shall be provided by the laboratory director/work or project supervisor will be given

1. at the time of an employee's or student's initial assignment to a work area where hazardous chemicals, biological agents, or equipment or instrumentation are present, and
2. prior to assignments involving new exposure situations.

The frequency of refresher information and training may be determined by the laboratory supervisor/instructor or the CISAT/SOE Chemical Hygiene and Safety Officer.

Safety information concerning chemical, biological or physical issues appropriate to a particular teaching or research laboratory/facility will be provided during safety training sessions held at the beginning of each semester to

- all persons (students, employees) directed to oversee any section of CISAT/SOE laboratory courses
- any student/employee involved in laboratory preparations
- any student/employee involved in laboratory-related projects.

***A copy of these "Laboratory Safety Rules" is to be given to each employee who is involved with any laboratory-based course or research project as part of the CISAT/SOE Safety Training Document. Students in CISAT/SOE courses involving laboratory or machine shop work should receive an abbreviated version, appropriate for their particular lab course, as part of the course syllabus.***

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## GENERAL GUIDELINES

1. **Responsible behavior in the laboratory is essential.** The dangers of spilled acids and other chemicals, as well as broken glassware created by thoughtless actions, are too great for irresponsible behavior to be tolerated.
2. **No unauthorized experiments in the laboratory.** Use only the quantities of reagents as instructed in written procedures, and no more. Consult your instructor if you have any doubts about the instructions in the laboratory manual or written procedure. Prior approval should be obtained from the supervisor/instructor whenever a new laboratory procedure, test or experiment is carried out, or there is a change in an existing procedure, test or experiment. Additional information concerning all chemicals—as potential hazards, safety issues when handling and disposing of them, and steps to take in case of accidental release (e.g., spill, leak)—is available by consulting the MSDS for that chemical. Knowledge of this type of information should be in hand BEFORE the experiment is started.
3. **Working alone in the laboratory is not permitted for undergraduate students.** At least one other person, aware that a student is working in the lab, should be present nearby in case of emergency.
4. **Work in the laboratory should be carefully ‘thought out’.** Plan ahead; do not “cookbook.” If you give no thought to what you are doing, you predispose yourself to an accident.

## LAB APPAREL (PERSONAL PROTECTIVE EQUIPMENT)

1. **Wear approved eye protection**—that which meets the requirements of ANSI Z87.1—*at all times* in all CISAT/SOE laboratories when there is a possibility of injury to the eyes because of ongoing chemical/biological laboratory procedures or engineering laboratory/machine shop operations (e.g., from chemical exposure, boiling water, projectiles).
  - a. Eye protection should protect against chemical splashes or physical impact. Goggles, or other special eye protection, must be worn by those who already wear prescription glasses.
  - b. If your eyes come into contact with an acid, alkali, abrasive or otherwise irritating substance, wash your eyes with flowing water from an eyewash station for at least 15 minutes. Seek medical attention immediately.
2. **Footwear that completely covers the feet is required when hazardous chemicals are present** because of the possibility of chemical spills, broken glassware on floors in chemical/biological laboratories, and other physical hazards that may be present in instrument/manufacturing/engineering laboratories and shops.

**A lab apron or coat must be worn**

- when you are wearing easily combustible clothing, such as synthetic and light fabrics,
  - when working with and/or transporting hazardous chemicals, and
  - when working in certain biological laboratories (e.g., Biosafety Level 2).
3. **Gloves should be worn when working with hazardous chemicals.** These gloves should be made of a material known to be resistant to permeation by that chemical. Inspect gloves before each use to assure structural integrity. If gloves are not disposable (e.g., thin latex or nitrile), wash them before removal and replace them as needed. (Heavy work gloves may be advisable or required in a manufacturing/engineering laboratory or shop.)

**CHEMISTRY/BIOCHEMICAL/BIOLOGICAL LAB POLICIES**

1. As part of the **safety orientation** to the laboratory, you will be shown the location of nearby fire extinguishers, fire blankets, safety showers and fire alarms. In addition, you will be informed of the location of the collection of Material Safety Data Sheets (MSDSs) in the laboratory, and you will be shown how to find information about a particular chemical of interest to you. If microbiological agents are to be used in the laboratory, information pertaining to ‘Standard Microbiological Practices’, as well as specific requirements for pathogens, mammalian viruses and cultured cells (all to be restricted to use in a Biosafety Level 2 facility) will be provided.

**All laboratory workers and students should know**

- how to learn about the hazards of a chemical as stated in the MSDS and other appropriate references pertaining to that chemical,
  - the location and proper use of emergency equipment, and
  - how and where to store chemicals properly when not in use.
2. **In case of fire or accident**, call the instructor at once. Small fires can be smothered by using a watch glass or other piece of glassware of appropriate size.
3. **In case of the chemical spill on your body or clothing**, wash the affected area with large quantities of running water. Remove clothing that has been wet by chemicals to prevent further reaction with the skin.
4. **In case of accidental ingestion of a chemical**, try to drink large volumes of water.
5. **Promptly clean** all chemical spills and **properly dispose** of the spilled chemical and cleanup material.
6. **Properly label and store all chemicals and equipment.** All chemicals (including solutions and chemicals transferred from their original containers) should be labeled with their names, concentrations and hazards—if they are known.

7. **Do not eat or drink *anything*, do not smoke, and do not apply cosmetics** in the laboratory. In addition, since many chemicals are absorbed through the skin, avoid direct skin contact. If you suspect skin contact with chemical substances, such as bottled reagents, wash off these substances with large quantities of water. Wash your hands thoroughly with soap and water before leaving the laboratory. In addition, do not store or handle food or beverages in laboratory areas, including refrigerators used for chemical storage.
8. **Report all injuries to your instructor at once.** Except for very superficial injuries, you will be required to get medical treatment for cuts, burns, or fume inhalation.
9. **Avoid deliberately and directly breathing fumes of any kind.**
  - a. To test the smell of a vapor, with your instructor's permission, collect some of the vapor in a cupped hand.
  - b. Work in a chemical fume hood if there is the possibility that noxious or poisonous vapors may be produced.
10. **Do not use mouth suction to fill pipettes** with water, chemical reagents (aqueous or organic), or biologicals. Always use a suction device that must be available in the laboratory.
11. **Confine long hair and loose clothing** in the lab, since either can catch fire or be chemically or biologically contaminated.
12. **Keep your work area neat at all times.** Clean up spills and broken glass immediately. Clutter not only will slow your work, but it leads to accidents. Clean your workspace, including wiping the surface and putting away all chemicals/biochemicals/biologicals and equipment, at the end of the laboratory preparation, course laboratory period or student project session.
13. **Be careful when heating liquids;** add boiling chips or beads to avoid "bumping." Flammable liquids such as ethers, hydrocarbons, alcohols, acetone, and carbon disulfide must not be heated over an open flame.
14. **Always carefully and slowly pour *acids into water*** when mixing to avoid spattering.
15. **Do not force a rubber stopper onto glass tubing or thermometers.** Lubricate the tubing and the stopper with glycerol or water. Use paper or cloth toweling to protect your hands. Grasp the glass close to the stopper.
16. **Dispose of excess reagents** as instructed, typically by collecting them in appropriately labeled waste containers. The instructor may permit flushing small quantities of chemicals down the sink.

17. **Properly label and store all chemicals and equipment.** All chemicals, biochemicals, and biologicals (e.g., solutions and chemicals/biochemicals transferred from their original containers, microbiological cultures) should be labeled with their names, concentrations (if appropriate) and hazards, if they are known.
18. **Do not block access to emergency equipment or exits.**
19. **All chemicals/biochemicals and biologicals, and their wastes, should be placed in their proper storage area at the end of the day.**
20. **All working surfaces and floors should be cleaned regularly.**
21. **Laboratory doors leading to hallways are to be closed during any laboratory activity.**
22. **Glassware:**
  - **Do not use broken, chipped, starred or cracked glassware.**
  - **Clean all glassware after use.**
  - **Do not pick up broken glassware with bare hands.** Use gloves or sweep up the glass fragments. Deposit broken glass in a “Broken Glass Safety Toss Box.”
  - **Handle hot glassware with proper size and type of tongs or hot mitts.**
23. **Vacuum and pressurizing equipment and materials:**
  - **Use a safety shield whenever an implosion might occur when working with vacuum equipment.** Shield or wrap Dewar flasks or other evacuated glass apparatus.
  - **Use steam or heating mantles to heat vacuum distillation flasks.**
  - **Relieve vacuum in all parts of system before opening apparatus.** Relieve vacuum slowly. Avoid sudden pressure changes that could cause breakage or spattering of contents. Do not relieve vacuum on heated apparatus until apparatus has cooled.
  - **Use a safety shield whenever an explosion might occur when working with pressurizing equipment.**
  - **Do not apply pressure to standard glassware.**
  - **Vent pressure in all parts of the system before opening.**
24. **Compressed gases:**
  - **Store and transport compressed gas cylinders with the safety caps on.**
  - **Transport large cylinders on a hand truck to which the cylinder is secured.**
  - **Cylinders should be clamped securely to a wall or other firm support with an appropriate cylinder clamp or chains.**

- **Always use a reducing valve with gas cylinders.**
- **Do not lubricate, modify or tamper with a cylinder valve.**
- **Do not heat cylinders or store them near a heat source.**

**25. Equipment in instrument/manufacturing/engineering laboratories and shop facilities must be used with care appropriate to the hazards they present. Personal protective equipment (PPE) appropriate to the work done or experiments performed should be available and used.**

## **VI. STANDARD OPERATING PROCEDURES TO ENSURE CHEMICAL/BIOCHEMICAL AND BIOLOGICAL SAFETY**

### **Chemical/Biochemical/Biological Agent Procurement**

To minimize storage space problems and waste disposal costs, only quantities of chemical anticipated for particular experiments planned, or those anticipated for ongoing laboratory courses, should be purchased. Larger quantities of commonly used chemicals, as solvents, may be purchased if proper storage space is confirmed to be available.

Biological agents (such as bacterial cultures, cultured cells, virus stocks) should be purchased (or otherwise received) in accordance with CISAT Biosafety regulations presented in this document.

### **Distribution**

Chemicals and biological agents that are to be transported from the receiving area should be put onto a cart and transported via the building freight elevators.

- Highly volatile liquids (as common lab solvents) and concentrated acids should be transported in appropriate containers (provided by the manufacturer) that minimize the likelihood of bottle breakage.
- Biological agents deemed to be hazardous, purchased (or otherwise received), shall be stored in accordance with CISAT Biosafety regulations presented in this document.

### **Storage**

#### Of chemicals

The major quantity of most chemicals should be stored in acid cabinets, flammables cabinets, or in appropriate storage areas in laboratory preparation rooms. (Only small quantities of chemicals should be transferred to secondary containers, properly labeled, and stored in the laboratories.)

Generally, chemicals should not be stored on bench tops, under hoods on lab floors, or atop cabinets. Any item—chemical or apparatus—must be stored with a clearance of at least 18 inches from a sprinkler head to allow proper functioning of the sprinkler system. Heavy materials should not be stored on high surfaces or shelves. Exits, passageways, areas under tables or benches, and emergency equipment areas must be free of stored equipment and materials.

Hazardous chemicals should be segregated in a well-identified area with proper ventilation.

Chemicals that are highly toxic should be kept in unbreakable secondary containers.

Stored chemicals should be examined annually for deterioration and container integrity.

Exposure of chemicals to heat or direct sunlight should be avoided.

Flammable liquids should be stored in approved flammable liquid storage cabinets.

Chemical storage areas must be established, so that storing incompatible reagents can be avoided.

Refrigerators used for chemical storage must be labeled “NO FOOD—CHEMICAL STORAGE ONLY.” **Flammable liquids must not be stored in any laboratory refrigerator unless that appliance is approved for such storage.**

Special precautions with gas cylinders:

- Cylinders should be labeled as to its contents. Reliance on the manufacturer’s color code is not advised.
- Gas cylinders should be strapped or chained to a wall or bench top.
- When a cylinder is no longer in use, the tank valve should be closed; pressure in gas regulator, released; the regulator, removed; and the tank valve should be capped. Empty cylinders should be strapped or chained properly until they are returned to the supplier.
- Gas cylinders stored should be kept away from other stored chemicals.
- Incompatible gases should be stored separately. Flammable gases should be stored away from reactives, including oxidizers and corrosives.
- Signs should be posted conspicuously in areas in which flammable compressed gases are stored. For example,

ACETYLENE—FLAMMABLE GAS  
NO SMOKING—NO OPEN FLAMES

#### Of biological agents

Biological pathogens, e.g., bacterial cultures other microbes that can cause disease, will be kept in the CISAT Biosafety Level 2 facility located on the first floor of the ISAT/CS building.

## Classes of Hazardous Chemicals/Biochemicals

### Combustibles and Flammables

Flammable liquids should not be heated with an open flame, hot plate or uninsulated resistance heaters. A heating mantle, steam bath or hot water bath should be used.

Flammable chemicals should not be stored near any source of ignition, spark or open flame. When transferring solvents from one container to another, if the potential for sparking exists, the containers should be electrically “grounded.”

Since long-term (chronic) exposures to solvents can cause damage to specific organs, as the kidneys and the liver, and since many halogenated solvents are carcinogens and/or teratogens,

- solvents are to be handled in an exhaust hood or a well-ventilated area, and
- large quantities of flammable reagents should be stored in appropriate safety cabinets.

### Corrosives/irritants

Concentrated acids will be stored in appropriate acid safety storage cabinets. Inorganic acids, as sulfuric, nitric and hydrochloric, should be stored separately from organic acids, such as acetic.

Acids and bases (including strong alkaline solutions) should not be stored in close proximity.

Since corrosive chemicals are highly reactive, dissolving and corroding (naturally) many different materials, and because some give off dangerous fumes,

- acids and bases are to be handled in an exhaust hood or a well-ventilated area, and
- large quantities of acids and bases should not be stored in the laboratories; instead, they will be stored in acid safety cabinets.

Because corrosives give off heat when diluted with water, one should always add acid to water. Doing so allows the heat to spread through the water instead of being concentrated in a small volume.

Mixing strong acids with strong bases is dangerous, and must be done slowly and with caution in a fume hood.

Since strong acids react with metals to generate explosive hydrogen gas, care must be used in dissolving metals in acids. Also, because mixing acids with solvents may lead to explosions, appropriate caution must be taken when strong oxidizers—such as nitric acid—and solvents are in proximity.

### Reproductive Toxins, High Acute Toxicity Chemicals, and Select Carcinogens

These types of chemicals should be properly labeled with appropriate warnings and stored in well-ventilated, limited-access, areas—in unbreakable secondary containers, if possible. All containers of these substances should be properly labeled with identity and warning labels.

These chemicals should be handled, only when properly attired (especially with suitable gloves to prevent skin contact), in only a “RESTRICTED ACCESS” fume hood or area of the lab posted with special warning signs. **This hood will be identified as having been tested and shown to be working properly.**

The hands, forearms, face and neck of anyone who manipulates these chemicals must be washed thoroughly before that person leaves the laboratory if exposure is suspected.

If a major spill occurs outside the hood, the area involved first must be evacuated; then the cleanup personnel, wearing suitable protective apparel and equipment, should begin the cleanup process. **The laboratory supervisor/instructor, as well as the Chemical Hygiene and Safety Officer, must be notified of all incidents of exposure or spills.** Chemical decontamination should be used whenever possible; containers of contaminated waste (including washings from contaminated flasks) must be transferred from the controlled area in secondary containers under the supervision of the laboratory supervisor/instructor or Chemical Hygiene and Safety Officer. Contaminated waste should be stored in closed, suitably labeled secondary containers. (For liquids, the containers should be plastic bottles half-filled with vermiculite). **NO CONTAMINATED WASTE MATERIALS SHOULD BE PLACED IN STANDARD LABORATORY TRASH RECEPTACLES.** Contaminated clothing or shoes should be discarded or incinerated if decontamination is not possible.

The controlled work area, including any equipment, including glassware, should be decontaminated before normal work in that area is resumed.

When a person is working with a chemical in a laboratory that is highly toxic or of unknown toxicity, another person in the building should be informed of the possible risk.

Breakable containers of these substances must be stored in chemically resistant trays. Work and storage surfaces are to be covered with removable, absorbent, plastic-backed paper.

Wet mopping—instead of dry sweeping—should be done for cleanup if the toxic substance was a dry powder.

### Compressed gases, liquefied gases, and cryogenic liquids

All gas lines leading from a compressed gas supply should be labeled clearly to identify the gas.

Cylinders should be transported carefully, not dragged, rolled, slid, or allowed to strike each other forcefully. They should be transported on wheeled cylinder carts with retaining straps or chains.

Once in place, cylinders should be secured firmly, individually, by means of clamp and belt or chain, to a wall or lab bench. The valve handle at the top should be accessible at all times.

The cylinder valve should be opened slowly, only when a proper regulator is in place.

Leak-testing should be performed when a problem with a cylinder is suspected. To check for leaks, a flammable gas leak detector or soapy water, or a 50% glycerin/water solution, may be used. If a leak at the cylinder valve handle cannot be remedied by tightening a valve gland or a packing nut, emergency action should be taken and the supplier should be notified.

All sources of ignition should be kept away from cylinders of flammable gases, e.g., oxygen, hydrogen, methane and acetylene.

Because of the special risk of eye and skin contact of personnel who work with cryogenic liquids (e.g., liquid nitrogen, helium and argon),

- eye protection—preferably safety glasses and a face shield—should be worn,
- gloves, impervious of the fluid, must be worn, and
- the area must be well-ventilated.

### **Hazardous (or Potentially Hazardous) Biological Agents (Bacterial Pathogens, Animal Viruses, Cultured Mammalian Cells) in a Biosafety Level 2 Environment**

#### **➤ Control Measures and Safety Equipment**

Laboratory ventilation should

- (1) provide a source of air for breathing and for input to local ventilation devices;
- (2) not be relied on for protection from toxic substances released into the laboratory

Chemical fume hoods should

- (1) be used for work with hazardous chemicals, especially toxic chemicals that have low air concentration limits, or that have high vapor pressures;
- (2) provide an average face velocity of 80 to 120 feet per minute (fpm) hood performance;
- (3) not be used as storage areas for chemicals, apparatus or other materials; and
- (4) not be used to evaporate solvents (except small quantities of volatile materials).

Also pertaining to fume hoods:

- Work inside the hood should be conducted at least six inches from the front edge of the hood.
- Hood sashes should be lowered at all times except when necessary to raise them to adjust apparatus inside the hood.
- The hood fan should be kept "on" whenever a chemical is inside the hood, whether or not any work is being done in the hood.
- Solid objects must not be allowed to enter the exhaust duct of the hood.
- Hoods should be inspected annually for a face velocity evaluation. **Any hood having inadequate performance should be repaired immediately.**

### Biological Safety Cabinets

Prior to being used with microbial pathogens or for animal cell culture/virus work, these cabinets shall be tested and certified by a representative of a company that specializes in biosafety cabinet certification and decontamination. Thereafter, the cabinet shall be recertified annually.

### Safety Equipment

Most laboratories are equipped with, or have readily accessible,

- an eyewash fountain
- a safety shower
- protective apparel compatible with the required degree of protection for substances being handled
- a fire extinguisher
- a fire blanket
- a first-aid kit

These safety apparatus should be located so that they can be reached readily from any point in the laboratory, and access to them must not be restricted or blocked in any way. In addition, a fire alarm and a telephone for emergency use should be available nearby.

Eyewash fountains and safety showers should be tested by the Chemical Hygiene and Safety Officer routinely once a month to see that they are functioning properly. If the water flow from the two spigots of an eyewash is not symmetrical, or if water flow from safety showers or eyewash fountains are deemed not adequate, the Chemical Hygiene and Safety Officer should request repair or assistance in correcting the problem.

Fire extinguishers will be inspected monthly by university personnel.

## Personal Protective Equipment (PPE)

Supplies and equipment, including but not limited to safety glasses, gloves, lab coats and aprons appropriate to the hazards present in a laboratory, shall be provided by either the laboratory supervisor or by the student (e.g., safety glasses required for certain lab courses). Policies for the use of these PPE will be posted in each lab.

### ➤ **Chemical/Biochemical and Biological Hazard Identification**

#### Chemicals/Biochemicals

Laboratory supply receiving personnel who unpack and distribute incoming chemicals should ensure that labels on containers of hazardous chemicals are not removed or defaced.

Material safety data sheets (MSDS), *vendor-specific*, will be available in each laboratory.

Laboratory-generated chemical substances:

- (1) If the composition of a chemical produced exclusively for laboratory use is known, available hazard information will be provided to employees exposed to the substance.
- (2) If the chemical produced is a byproduct whose composition is not known, the substance should be assumed to be hazardous and handled according to the *CISAT/SOE Chemical Hygiene, Laboratory Equipment, and Biological Facility Safety Plan*.

#### Biological Agents

[Most of the information in this section was taken from an on-line pdf document posted by the University of Colorado, Boulder Institutional Biosafety Committee as “IBC Requirements for Laboratory Operating Practices, Physical Containment, and Training for Research Involving Biological Agents.” (Document footer: EHS/IBC doc. 2/16/07 dd)

<http://ehs.colorado.edu/BioSafetyDocs/IBCGuidContanLabs.pdf>

Changes were made as needed to apply to facilities on the JMU campus to which this safety document applies. *Most importantly, these ‘standards’ parallel the current NIH guidelines cited in Section II of this document.*

The James Madison University Institutional Biosafety Committee (IBC), the CISAT Chemical Hygiene and Safety officer, and the University Environmental Health Coordinator, require that the following standard and special microbiological practices, physical containment or laboratory design, containment equipment, and training be implemented when using organisms containing recombinant DNA or biological agents that are known or potential biohazards. These requirements include hygienic and operational practices that are critical in providing for a safe work environment and assuring a viable research product is produced. These practices

are also necessary for minimizing and/or eliminating the risk of occupational exposure to infectious and potentially infectious substances.

The Principal Investigator is responsible for having their laboratory area meet the specified requirements for the biosafety containment level that corresponds to the biological agents in use. Failure to meet these requirements will result in a review by the IBC. The Principal Investigator will work with the IBC to correct all deficiencies in a timely manner.

### **Standard Practices and Training**

The first principle of containment is strict adherence to good microbiological practices. Consequently, all personnel directly or indirectly involved in experiments using recombinant DNA shall receive adequate instruction. At a minimum, these instructions include training in aseptic techniques and in the biology of the organisms used in the experiments so that the potential biohazards can be understood and appreciated.

Any research group working with agents that are known or potential biohazards shall have an emergency plan that describes the procedures to be followed if an accident contaminates personnel or the environment. The Principal Investigator shall ensure that everyone in the laboratory is familiar with both the potential hazards of the work and the emergency plan. If a research group is working with a known pathogen for which there is an effective vaccine, the vaccine should be made available to all workers. Serological monitoring, when clearly appropriate, will be provided.

### **Physical Containment Levels**

The objective of physical containment is to confine organisms containing recombinant DNA molecules and to reduce the potential for exposure of the laboratory worker, persons outside of the laboratory, and the environment to organisms containing recombinant DNA molecules. Physical containment is achieved through the use of laboratory practices, containment equipment, and special laboratory design. Emphasis is placed on primary means of physical containment that are provided by laboratory practices and containment equipment. Special laboratory design provides a secondary means of protection against the accidental release of organisms outside the laboratory or to the environment. Special laboratory design is used primarily in facilities in which experiments of moderate to high potential hazard are performed.

Combinations of laboratory practices, containment equipment, and special laboratory design can be made to achieve different levels of physical containment. There are four levels of physical containment, which are designated as BL1, BL2, BL3, and BL4. It should be emphasized that the descriptions and assignments of physical containment detailed below are based on existing approaches to containment of pathogenic organisms. The National Cancer Institute describes three levels for research on oncogenic viruses that roughly correspond to NIH BL2, BL3, and BL4 levels. Currently, the facilities within CISAT contain laboratories that require only BL1 and BL2 practices and physical

containment. Hence, only ‘standards’ that are appropriate to these biosafety levels are detailed in this document.

It is recognized that several different combinations of laboratory practices, containment equipment, and special laboratory design may be appropriate for containment of specific research activities. The selection of alternative methods of primary containment is dependent, however, on the level of biological containment provided by the biological agent used in the experiment. Consideration will be given to other combinations that achieve an equivalent level of containment.

## **Biosafety Level 1 (BL1)**

### **BL1 Standard Microbiological Practices**

- Access to the laboratory is limited or restricted at the discretion of the Principal Investigator when experiments are in progress.
- Work surfaces are decontaminated at least once a day and after work with infectious materials is finished, and after any spill of viable material is cleaned with disinfectants that are effective against the agents of concern.
- All contaminated liquid or solid wastes are decontaminated before disposal as stipulated later in this section (below)
- Mechanical pipetting devices are used; mouth pipetting is prohibited.
- Policies for the safe handling of sharps are instituted. Needles should not be bent, sheared, replaced in the needle sheath or guard, or removed from the syringe following use. The needle and syringe should be promptly placed in a puncture-resistant ‘sharps’ container and removed as stipulated later in this section (below).
- Eating, drinking, smoking, and applying cosmetics are not permitted in the work area. Food may be stored in cabinets or refrigerators designated and used for this purpose only. No preparation, storage or consumption of food or drink is permitted in the lab.
- Persons wash their hands: (i) after handling materials involving organisms containing recombinant DNA molecules and animals (ii) before exiting the laboratory
- All procedures are performed carefully to minimize the creation of splashes or aerosols.
- In the interest of good personal hygiene, facilities (e.g., hand washing sink, shower, changing room) and protective clothing (e.g., uniforms, laboratory coats) shall be

provided appropriate for the risk of exposure to viable organisms containing recombinant DNA molecules.

- A biohazard sign must be posted at the entrance to the laboratory whenever infectious agents are present. The sign must include the name of the agent(s) in use and the name and the phone number of the investigator.

#### BL1 Special Practices

- Contaminated materials that are to be decontaminated at a site away from the laboratory are placed in a durable leak-proof container that is closed before being removed from the laboratory.
- An insect and rodent control program is in effect.

#### BL1 Containment Equipment

- Special containment equipment is generally not required for manipulations of agents assigned to BL1.
- Gloves should be worn if the skin on the hands is broken or if a rash is present.
- Protective eyewear should be worn for conduct of procedures in which splashes of microorganisms or other hazardous materials is anticipated.

#### BL1 Laboratory Facilities

- Laboratories should have doors for access control.
- The laboratory is designed so that it can be easily cleaned. Carpets and rugs in laboratories are not appropriate.
- Bench tops are impervious to water and resistant to acids, alkalis, organic solvents, and moderate heat.
- Laboratory furniture is sturdy. Spaces between benches, cabinets, and equipment are accessible for cleaning.
- Each laboratory contains a sink for hand washing. Foot, knee, or automatically operated sinks are recommended.
- If the laboratory has windows that open, they are fitted with fly screens.

## **Biosafety Level 2 (BL2)**

### BL2 Standard Microbiological Practices

- All procedures for BL1 Standard Microbiological Practices, AND
- Experiments of lesser biohazard potential can be conducted concurrently in carefully demarcated areas of the same laboratory.

### BL2 Special Practices

All BL1 Special Practices, AND

- The Principal Investigator limits access to the laboratory. The Principal Investigator has the final responsibility for assessing each circumstance and determining who may enter or work in the laboratory. For example, persons who are immunocompromised or immunosuppressed may be at increased risk of acquiring infections.
- The Principal Investigator establishes policies and procedures whereby only persons who have been advised of the potential hazard and meet any specific entry requirements (e.g., immunization) may enter the laboratory or animal rooms.
- When the organisms containing recombinant DNA molecules in use in the laboratory require special provisions for entry (e.g., vaccination), a hazard warning sign incorporating the universal biosafety symbol is posted on the access door to the laboratory work area. The hazard warning sign identifies the agent and the biosafety level, lists the name and telephone number of the Principal Investigator or other responsible person(s), and indicates the special requirement(s) for entering and exiting the laboratory (e.g., immunization, personal protective equipment). Please see last page of this document for an example of an appropriate hazard warning sign.
- Laboratory coats, gowns, smocks, or uniforms are worn while in the laboratory. Before exiting the laboratory for non-laboratory areas (e.g., cafeteria, library, administrative offices), this protective clothing is removed and left in the laboratory or covered with a clean coat not used in the laboratory.
- Animals not involved in the work being performed are not permitted in the laboratory.
- Special care is taken to avoid skin contamination with organisms containing recombinant DNA molecules; gloves should be worn when handling experimental animals and when skin contact with the agent, contaminated surfaces or equipment is unavoidable. Wearing two pairs of gloves may be appropriate. Gloves are disposed of when overtly contaminated, and removed when work with infectious materials is completed or when the integrity of the glove is compromised. Hands are washed following removal of gloves.

- All wastes from laboratories and animal rooms are appropriately decontaminated before disposal.
- Broken glassware must not be handled directly by hand, but must be removed by mechanical means such as a brush and dustpan, tongs, or forceps. Broken glassware should be promptly placed in a puncture-resistant container and decontaminated if needed.
- Spills and accidents that result in overt exposures to organisms containing recombinant DNA molecules are immediately reported to the Institutional Biosafety Committee. Medical evaluation, surveillance, and treatment are provided as appropriate and written records are maintained.
- Laboratory personnel receive appropriate immunizations or tests for the agents handled or potentially present in the laboratory.
- When appropriate, considering the agent(s) handled, baseline serum samples for laboratory and other at-risk personnel are collected and stored. Additional serum specimens may be collected periodically depending on the agents handled or the function of the facility.
- A biosafety manual is prepared or adopted. Personnel are advised of special hazards and are required to read and follow instructions on practices and procedures.
- The Principle Investigator ensures that laboratory and support personnel receive appropriate training on the potential hazards associated with the work involved, the necessary precautions to prevent exposures, and the exposure evaluation procedures. Personnel receive annual updates or additional training as necessary for procedural or policy changes.

#### BL2 Containment Equipment

- All BL1 Containment Equipment, AND
- Properly maintained biological safety cabinets (Class I or II), preferably Class II, or other appropriate personal protective or physical containment devices are used whenever:
  1. Procedures with a high potential for creating aerosols are conducted. These may include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, opening containers of materials whose internal pressures may be different from ambient pressures
  2. High concentrations or large volumes of organisms containing recombinant DNA molecules are used. Such materials may be centrifuged in the open

laboratory if sealed beads or centrifuge safety cups are used and if they are opened only in a biological safety cabinet.

- A properly maintained biological safety cabinet (Class I or II), will have a current, annual certification that under normal operating circumstances the unit performs to manufacturer's specification.
- Face protection (goggles, mask, face shield or other splatter guard) is used for anticipated splashes or sprays of infectious or other hazardous materials to the face when the microorganisms must be manipulated outside the biological safety cabinet.

### BL2 Laboratory Facilities

- All BL1 Laboratory Facility Requirements, AND
- Provide lockable doors for facilities that house restricted agents.
- Install biological safety cabinets in such a manner that fluctuations of the room supply and exhaust air do not cause the biological safety cabinets to operate outside their parameters for containment. Locate biological safety cabinets away from doors, from windows that can be opened, from heavily traveled laboratory areas, and from other potentially disruptive equipment so as to maintain the biological safety cabinets' air flow parameters for containment.
- An eyewash station is readily available.
- Illumination is adequate for all activities, avoiding reflections and glare that could impede vision.
- An autoclave for decontaminating laboratory wastes is available.

### Biological Safety Cabinets

Biological safety cabinets referred to in this section are classified as Class I and Class II cabinets. Additional information on biological safety cabinets is published as a CDC-NIH web page:

<http://www.cdc.gov/od/ohs/biosfty/bsc/bsc.htm>

Class I - a ventilated cabinet for personnel protection having an inward flow of air away from the operator. The exhaust air from this cabinet is filtered through a high efficiency particulate air/HEPA filter. This cabinet is used in three operational modes: (i) with a full-width open front, (ii) with an installed front closure panel (having four 6-inch diameter openings) without gloves, and (iii) with an installed front closure panel

equipped with arm-length rubber gloves. The face velocity of the inward flow of air through the full-width open front is 75 feet per minute or greater.

Class II - a ventilated cabinet for personnel and product protection having an open front with inward air flow for personnel protection, and HEPA filtered mass recirculated air flow for product protection. The cabinet exhaust air is filtered through a HEPA filter. The face velocity of the inward flow of air through the full-width open front is 75 feet per minute or greater. Design and performance specifications for Class II cabinets have been adopted by the National Sanitation Foundation, Ann Arbor, Michigan.

### **Chemical and Biological Waste Disposal**

Hazardous chemical waste will be stored in a designated location for off-site disposal

Potentially hazardous biological/physical waste (e.g., Petri dishes with bacterial colonies, sharps containers) will be removed (from appropriately labeled containers located in select CISAT/SOE laboratories) and appropriately packaged for disposal by JMU Housekeeping personnel specially trained in handling of these wastes.

### **Instrument/Equipment Safety**

In the introductory section pertaining to “Laboratory Equipment” in *Prudent Practices* (1995) is this statement: “Proper use of laboratory equipment is required to work safety with hazardous chemicals. Maintenance and regular inspection of laboratory equipment are an essential part of this activity. Many of the accidents that occur in the laboratory can be attributed to improper use or maintenance of laboratory equipment.”

Requirements and recommendations concerning safety with equipment commonly located in CISAT chemical laboratories appear below. (*These safety issues apply to all CISAT/SOE equipment/apparatus including, but not limited to, those listed.*)

Water-cooled equipment (e.g., distillation apparatus):

The major problem with cooling water is localized flooding due to the disconnection of tubing supplying water to the condenser. Tubing connections should be checked frequently, and the entire apparatus should be operated when the laboratory is occupied.

Electrically-powered equipment (including fluid and vacuum pumps, lasers, power supplies, both electrophoresis and electrochemical apparatus, stirrers, hot plates, water baths, heating mantles, microwave ovens and ultrasonicators):

The major hazard is electrical, as a shock hazard and as a source for flammable or explosive vapors. All electrical equipment must be installed and maintained according to the provisions of the National Electric Code (NEC) of the National Fire Protection Association (NFPA).

All repair and calibration work must be carried out by properly trained and qualified personnel.

Before modification, installation, or even minor repairs of electrical equipment are carried out, the devices must be deenergized, and all capacitors, discharged safely.

Receptacles that provide electric power for operations in hoods should be located outside the hood, a step which prevent the production of electric sparks inside the hood. In addition, cords should not dangle outside the hood in such a way that they accidentally can be pulled out of their receptacles or tripped over.

General precautions for working with electrical equipment:

1. All equipment must be insulated properly. During equipment use, if frayed or damaged cords are found, they must be replaced before further use of the equipment is permitted. The complete electrical isolation of electrical equipment and power supplies must be ensured to prevent the possibility of accidental contact with electrical circuits.
2. Electrical equipment, e.g., heat guns or hot plates, which may generate sparks must be isolated from volatile solvents.
3. To minimize the possibility of electrical shock, adequate grounding will be provided for all electrical equipment.
4. Pieces of equipment should be unplugged prior to adjusting, modifying or repairing them.

Personal safety techniques for use with electrical equipment:

1. Contact with energized electrical circuits must be avoided. Electrical equipment should be serviced by only qualified individuals, and only after power has been disrupted and capacitors are discharged. Before electrical equipment is reconnected to power after servicing, it must be tested to ensure proper grounding.
2. If a circuit breaker “trips,” steps must be taken to assure that the overload or short-circuit which caused the failure is corrected.
3. Ground-fault circuit interrupters must be in place where required, particularly if an electrical device is hand-held during a lab operation.

Electrical equipment used in CISAT/SOE laboratories requiring special precautions:

#### Ultrasonicators

- Direct contact of the body with liquids or solids subjected to high-intensity ultrasound should be avoided.

#### Centrifuges

- Centrifuges should be properly installed and must be operated by only trained personnel.
- The load must be balanced each time the centrifuge is used, and the lid must be closed while the rotor is moving.

Electrical Instruments and Appliances (e.g., circuit testing equipment, electrophoresis power supplies, microscopes, ovens, water baths, hot

plates and stirring devices, top-loading and analytical balances, microwave ovens, pH and specific ion meters, vacuum pumps, refrigerators and freezers):

- For all equipment, a chassis ground must be in place.
- Special precautions should be taken to avoid the possibility that water or other chemicals could be spilled onto these instruments.
- Only qualified individuals should make repairs.

Electromagnetic Radiation Hazards (e.g., UV sources, lasers, microwave sources)

- Overexposure to UV light, direct or reflected, should be minimized. Lamp sources should be sealed or enclosed whenever possible, and appropriate eye protection and/or face shields should be worn. Long-sleeved clothing and gloves should be worn to protect arms and hands.
- Lasers:
  - ⇒ Users of class III A and B, and class IV, lasers must wear appropriate eye protection and clothing to prevent damage to eyes and skin when direct laser beam exposure is remotely possible. **(NOTE: When laser demonstration/laboratory exercises are in process in a CISAT/SOE laboratory, if the laser beam is split by means of a diffraction grating so that several low-energy beams can be projected onto a surface, safety glasses may be set aside to facilitate the laboratory activity. However, precautions must be taken so that it is ensured that operators of laser equipment, as well as observers, do not look directly into the beam with unprotected eyes, and that the laser points only at the intended projection wall or screen.)**
  - ⇒ Area where a laser is in operation must be posted accordingly.
  - ⇒ Anyone who is not the authorized operator of a laser system, or who is not authorized to be present by the operator, should not enter a posted laser-controlled laboratory if the laser is in use.

Microwave sources must be operated only with appropriate microwave generator shielding in place. Avoid metal in microwave ovens, since arcing may occur, causing the ignition of any solvents present. Since superheating of liquids can occur, capping of vials and other containers can result in explosion from pressure buildup within the vial. Use only selected plastic containers.

Those persons using electrically powered equipment and tools, used in machine shops must use caution to avoid damaging power cords. Also, using this equipment in the presence of potentially hazardous chemicals, e.g., flammable solvents, should be avoided.

### **Records**

The James Madison University Environmental Health Coordinator and members of the Department of Human Resources shall maintain an accurate record of any measurements taken to monitor employee exposures, and any medical consultations and examinations, including tests or written opinions required by this plan. He/she will assure that such records are kept, transferred and made available in accordance with 29 CFR 1910.20.

## VII. BLOODBORNE PATHOGENS CONTROL PROGRAM

**Introduction.** The Occupational Safety and Health Administration (OSHA), in 1992, promulgated a standard, published as 29 CFR 1910.1030, pertaining to minimizing exposure to bloodborne pathogens in the workplace.

[http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10051](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10051)

This standard pertains to job-related contact with blood or other body fluids (defined by OSHA as human semen, vaginal secretions, cerebrospinal fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any fluid visibly contaminated with blood, and indistinguishable body fluids).

In March, 1999, James Madison University published Policy 3109 (*Bloodborne Pathogens*) to establish the Bloodborne Pathogens Control Program. This program “is designed to help prevent the spread of HIV (Human Immunodeficiency Virus) and HBV (Hepatitis B virus) infections to persons who may be reasonably expected to come into contact with blood and other body fluids as part of their work/activities.” OSHA defines an exposure incident as “a specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that results from performance of an employee’s duties.”

Because the university policy states that department heads of “at risk” personnel are responsible for developing and implementing exposure control plans, the CISAT/SOE Associate Dean’s requested that a program to eliminate, or at least minimize, bloodborne pathogen exposure be put into place for all CISAT/SOE laboratories and the university machine and electronics shops.

**University Resources.** The *CISAT/SOE Laboratory Bloodborne Pathogen Exposure Control Plan* is intended to parallel the James Madison University *Bloodborne Pathogens Policy Document 3109*:

<http://www.jmu.edu/JMUpolicy/3109.shtml> ,

and the plan of the CISAT Department of Nursing:

<http://www.nursing.jmu.edu/msn/exposurepolicies.html> .

The University Health Center offers information and training:

<http://www.jmu.edu/bbp/index.shtml> .

**Identification of “At Risk” Personnel.** A listing of those persons “who could be ‘reasonably anticipated,’ as a result of performing their job duties, to have contact with blood and other potentially infectious materials” will be kept by the CISAT/SOE Chemical Hygiene and Safety

Officer. This person will inform the heads of the departments to which these “at risk” personnel belong as to the need for annual bloodborne pathogen exposure control training.

**Training.** According to the *JMU Policy 3109: Bloodborne Pathogens (June 24, 2001 revision)*, all persons in “at risk” positions will be provided training by the university. This training program is two-fold:

- 1) Medical training is provided by the university health center, and will provide information about these topics:
  - What are bloodborne pathogens?
  - Who is at risk?
  - What is exposure?
  - How is an exposure incident handled?
  - How does the employee protect himself/herself?
  - What is the nature of vaccines available, and when should one be vaccinated?
  
- 2) Departmental training for all persons in “at risk” positions must be conducted annually. Besides providing information pertaining to hazardous materials, location of the CISAT/SOE Safety Manual, and OSHA regulations pertaining to bloodborne pathogen exposure, this exposure control plan will be reviewed. Topics will include:
  - Definition of “at risk” positions for the college
  - Description of specific job duties/tasks which place the employee at risk
  - Description of proper performance of job duties to prevent disease transmission (e.g., hand washing, use of gloves)
  - Description of engineering and work practice controls which are in place to reduce the likelihood of exposure (e.g., “sharps” disposal containers, biohazard bags)
  - Description of hazard communication (e.g., warning labels)
  - Description of personal protective equipment available in the college and its proper use (e.g., latex gloves)
  - Description of decontamination and disposal procedures of personal protective equipment and infectious waste or materials (e.g., clean-up procedure, proper use of bleach)
  - Description of other protective practices required by the college
  - Reporting process for an exposure incident
  - Discussion of engineering and work practice controls which may need to be examined and evaluated for their effectiveness

**Maintenance of this program.** The CISAT/SOE Chemical Hygiene and Safety Officer maintains this program. Heads of departments in the college are periodically to inform those

members of his/her faculty and staff about the program, and to refer those employees designated “at risk” for exposure to bloodborne pathogens for annual training. The CISAT/SOE Chemical Hygiene and Safety Officer possesses “Bloodborne Pathogen Control Program” kits for both training purposes and will be available to CISAT/SOE “at risk” personnel in case of possible bloodborne pathogen exposure.

**Post-Exposure Evaluation and Follow-Up.** As stated in the *JMU Policy 3109*, employees (whether “at risk” or other) will contact his/her designated supervisor to determine if an exposure incident is related to this bloodborne pathogen standard. If so, the supervisor will immediately contact and refer the employee to the Rockingham Memorial Hospital Emergency Room for medical evaluation. (Note that persons involved may sign a waiver refusing medical assessment and treatment.)

## **VIII. FACULTY/STUDENT PROJECTS REQUIRING APPROVAL**

Any projects that would involve large amounts of chemicals/biochemicals deemed particularly hazardous, e.g., flammable solvents, caustics, carcinogenic or mutagenic substances, **MUST** be approved by the CISAT/SOE Chemical Hygiene and Safety Officer (who will consult and inform the University Environmental Health Coordinator) prior to receipt of these chemical agents in any CISAT/SOE facility.

## IX. REFERENCES

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