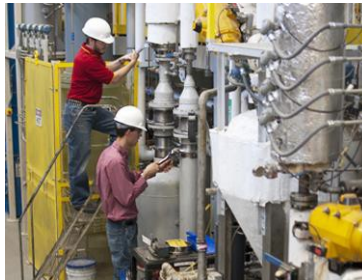


IOWA STATE UNIVERSITY

BioCentury Research Farm



BioCentury Research Farm

Safety Manual

www.biocenturyresearchfarm.iastate.edu

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Introduction

The purpose of the BioCentury Research Farm (BCRF) Safety Manual is to provide users with information designed to ensure health and safety. This manual is not intended to be all-inclusive, but should serve instead to supplement more specific procedures developed for specific activities. All BCRF personnel and users must have access to this document as a basis for working safely in BCRF facilities.

In addition, the [Iowa State University Laboratory Safety Manual](#) outlines appropriate practices, university policies, and other regulations that must be followed in a laboratory setting.

Contact Information

Emergency Coordinators

Name	Title	Office Number	Emergency Number
Alex Wiley	Emergency Management	(515) 294-9253	
Bill Diesslin	Coordinating Official	(515) 294-2105	
Robert Hartmann*	BCRF Building Systems Specialist	(515) 296-6302	(312) 914-7828
**Andy Suby	BCRF Assistant Director	(515) 296-6039	(515) 509-6326
**Matt Darr	BCRF Director	(515) 294-8545	(740) 502-3753

*Primary emergency coordinator

**The assistant director and director of the BCRF should always be notified of an emergency situation.

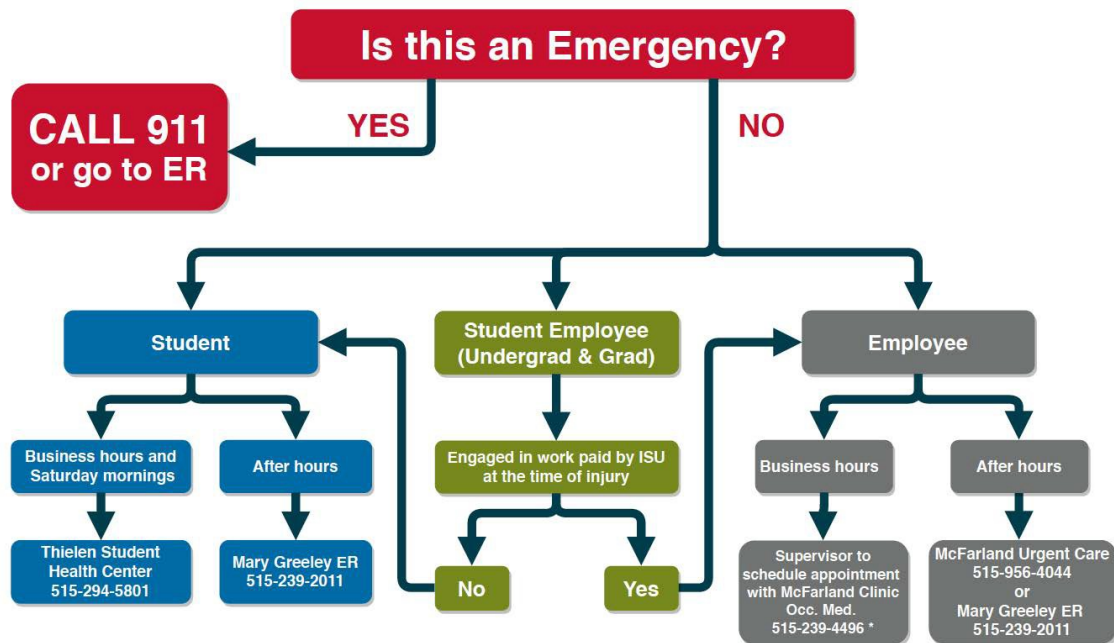
Environmental Health and Safety (EH&S) Contacts

EH&S Front Desk(515) 294-5359

Duty Officer Primary EH&S Contact (after hours).....(515) 460-5051

Emergency Contacts

Fire or Explosion	
Boone Police	911 or (515) 432-2211
Boone Fire Department	911 or (515) 432-3446
Injury	
Boone County Hospital	911
Ambulance	911
Poison	
Poison Control Center	(800) 222-1222
Chemical Spill/Release	
During Business Hours:	
Environmental Health & Safety	(515) 294-5359
After Hours:	
Department of Public Safety	(515) 294-4428



Emergency Procedures

Emergency Procedures for a Fire

1. Activate the fire alarm. In the event of a fire or any emergency requiring building evacuation, it is essential to activate the nearest fire alarm pull station.
2. Call 911. Telephone 911 and give your name, location, nature of the emergency, and telephone number. Make sure that you give the correct address: BioCentury Research Farm or BCRF, 1327 U Avenue, Boone, Iowa.
3. Extinguish small fires. If the fire is small and a person has been trained to use a fire extinguisher, they may attempt to extinguish the fire. A fire extinguisher should only be used by a trained person after the fire alarm has sounded and 911 called. *Do not attempt to extinguish any fire if there is a threat to your safety.*
4. Exit the building. If there is sufficient time, ensure that equipment and experiments are in a safe condition before leaving the area. The parking lot located on the north side of the BCRF office building is the primary meeting area after an emergency evacuation. If smoke makes the primary meeting area difficult, proceed to the southeast corner of the Biomass Storage and Pretreatment Building.
5. Account for all personnel and visitors. Once everyone has evacuated to the designated area, supervisors should account for all personnel and visitors to make sure everybody is out of the building.
6. Report hazardous conditions to responding emergency personnel.
7. Stay away from the building until it is safe to return. Do not re-enter the building until advised to do so by the responding emergency personnel.

Emergency Procedures for a Chemical Spill

1. If necessary remove the injured and use emergency shower for 10-15 minutes.
2. Warn others of the hazard, everyone leave the facility.
3. Immediately identify character, source, amount, and real extent of any released materials. Identify the material by container label. If the container label is defaced or obscured, look for any kind of markings that might help in identifying the contents. If there are no visible markings determine the types of containers stored around the leaking container. Chemicals should be stored together by hazard class. If no information can be obtained, collect a representative sample of the material for analysis.
4. Call an EH&S emergency coordinator using the [call list](#), start at the top.
5. Stop the leak if feasible.
6. Remove ignition sources if necessary.
7. Increase the ventilation of the room to remove the vapors.
8. Isolate the area and post warning signs.

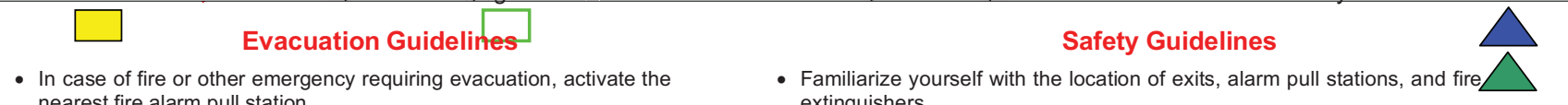
9. Liquid spills should be covered with an absorbent material. If the material is migrating, build a dike around the spill to contain it. The dike can be built using absorbent.
10. Dry material should be evaluated to determine best collection procedures. Water reactive solids should be covered with inert material and collected.
11. If the spill is from a leaking container, transfer the container into a larger container or containment device. This should be done as quickly as possible. Next, transfer the container to a fume hood for treatment or disposal.
12. If the spill is from a leaking drum or tank, transfer the contents to an appropriate container using a pump designed for transferring the liquid.
13. Clean up the spilled material and put it in a containment device. Dispose of in the same manner as the original product. Wash the surface with cleaning solutions and water. Clean up should follow immediately after containment and removal of the chemical.

Tornado and Severe Weather Guidelines

In the event of a tornado or other severe weather event, proceed to the BCRF tornado shelter areas in the Biomass Processing Facility, which are located in the hallway between the laboratories (hallway 1120-2), lab 1133, and in either bathroom (Men 1125 or Women 1123). Refer to [emergency maps on pages 10-11](#) for details.

A weather radio is located on the west wall of each research bay and in the office cubicle area. The weather radios should be turned on at all times. When conditions are favorable for tornados, the National Weather Service will issue a tornado watch. If a tornado warning is issued, this means that a tornado is occurring or is imminent. Employees and visitors to the BCRF should immediately take cover in the tornado shelter if a tornado warning is issued. The weather radio should be brought into the shelter to monitor conditions. Anyone who hears that a severe weather watch or warning has been issued for the BCRF area is responsible for notifying all others in the BCRF facilities of the situation and ensuring the weather radio is brought into the tornado shelter.

Biomass Processing Facility – First Floor



- Exit in a calm and orderly fashion. Once you have evacuated to a safe location, immediately call 911.
- Assist injured personnel, if time permits, and make sure all doors are closed and hazardous work operations are shut down as you exit.
- Help any physically impaired individuals in need of assistance.
- **In case of evacuation, meet at the NW corner of the north parking lot.**

- Attempt to control a fire yourself with a fire extinguisher only when the fire is small and you have been trained.
 - Keep fire doors closed to prevent the spread of smoke and fire.
- Severe Weather**
- In the event of a tornado, proceed to the restrooms, lab 1133, or hallway between lab 1133 and lab 1135 (1120-2). Keep away from exterior doors and windows.

The floor plan shows a large rectangular room divided into several sections. At the top left is a 'STORAGE 2001B' area. Below it are two 'MECHANICAL ROOM 200T' areas, each containing a 'FIRE EXTINGUISHER' icon. A central staircase is labeled 'DOWN'. To the right of the stairs is a 'TELECOM 200TA' area. The bottom section contains various equipment and furniture. Red arrows indicate exit directions from different points in the room.

<p>Exits</p> <ul style="list-style-type: none"> In case of fire or other emergency requiring evacuation, activate the nearest fire alarm pull station. Exit in a calm and orderly fashion. Once you have evacuated to a safe location, immediately call 911. Assist injured personnel, if time permits, and make sure all doors are closed and hazardous work operations are shut down as you exit. Help any physically impaired individuals in need of assistance. In case of evacuation, meet at the NW corner of the north parking lot. 	<p>Key</p> <p>Fire Extinguisher Fire Alarm Pull Station</p> <p>Evacuation Guidelines</p> <ul style="list-style-type: none"> Familiarize yourself with the location of exits, alarm pull stations, and fire extinguishers. Attempt to control a fire yourself with a fire extinguisher only when the fire is small and you have been trained. Keep fire doors closed to prevent the spread of smoke and fire. Severe Weather In the event of a tornado, proceed to the restrooms, lab 1133, or hallway between lab 1133 and lab 1135 (1120-2). Keep away from exterior doors and windows.
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Standard Operating Procedures

Specific standard operating procedures (SOP) are essential to safety at the BCRF. Development of SOPs requires each supervisor or group to assess (i.e., identify and evaluate) all chemical, biological, radiological, and physical hazards associated with BCRF operations and describe safety precautions necessary to avoid employee exposures and injuries. SOPs must be specific to each job task.

SOPs must be reviewed and approved by the principle investigator (PI) or the group supervisor. After approval, SOPs are then incorporated into or attached to written materials and methods filed on site at the BCRF with access to any persons affected by the procedure. Personnel must be trained on the elements of the SOPs. At minimum, SOPs must include the following:

- Name of the procedure.
- An overview of the procedure including the steps required in the process.
- Health and safety information for materials used: list and briefly describe the chemical, biological, radiological, and physical hazards associated with the operation. Identify available resources like safety data sheets (SDS) and specify where they can be accessed.
- Hazard control measures: include containment devices, ventilation, specific personal protective equipment, and hygiene practices as recommended by the SDS or other authoritative guide. Evaluate whether special procedures discussed below will be required.
- Waste disposal practices: establish procedures for the safe and timely removal of waste.
- Decontamination procedures: develop procedures and use in contaminated areas with required frequency and duration.
- Spill/release containment and clean up procedures: [see pages 8-9](#) of this manual.
- Any special procedures necessary.

SOPs must be readily available in the area where the experiment or operation will be performed. SOPs should be reviewed and updated annually or when there is a change to a procedure.

General Safety Policies

Accidents and Injuries

Accidents and/or injuries requiring immediate medical attention should be addressed by contacting Emergency Services by dialing 911 or by seeking immediate medical attention at the Boone County Hospital located at 1015 Union Street, Boone, Iowa. Driving instructions can be found in [Appendix A](#).

All accidents and injuries occurring at the BCRF should be reported to EH&S and the BCRF assistant director.

Iowa State University (ISU) employees and students exposed or injured while at work or in the course of employment must seek non-emergency medical attention at the McFarland Clinic Occupational Medicine Department at 1215 Duff Ave, Ames, Iowa, (515) 239-4496. McFarland Clinic is the workers compensation provider for Ames-area ISU personnel. The clinic provides consultation, evaluation, and treatment for all work-related injuries, illnesses, and exposures. Supervisors should call the McFarland Clinic Occupational Medicine Department during regular work hours to schedule an appointment for the employee. Any relevant safety information such as an SDS should accompany the employee to the appointment. After hour treatment will be seen at Boone County Hospital emergency room or Mary Greeley emergency room.

Personal vehicles should never be used as transportation to the hospital. University owned vehicles should be used to transport to the hospital only if the injured is in stable condition and an ambulance is not required.

All work-related injuries, illnesses, or exposures must be reported to the employee's supervisor, even when medical attention is not required or is refused by the employee:

- A First Report of Injury must be completed through [Environmental Health and Safety](#) by the supervisor and submitted within 24 hours of the incident. Use the ISU Incident Portal – First Report of Injury button for the online questionnaire. Questions regarding the form may be forwarded to Human Resource Services at (515) 294-3753.
- An Accident Investigation Form must be completed by the supervisor and sent to EH&S within seven business days of the incident. Questions regarding completion of accident investigations may be forwarded to EH&S at (515) 294-5359.

Injured persons who are not ISU employees (i.e., working for a private firm leasing BCRF space) must seek non-emergency medical attention as determined by their employer.

Lockout of Hazardous Energies

The application of the lockout program is intended to prevent equipment from unexpectedly being set in motion and endangering workers. Potential hazardous energy sources must be identified, isolated, and locked and/or tagged out before starting a service or maintenance task. Typical tasks requiring lockout/tagout (LOTO) procedures include:

- A task requiring an employee to enter a machine's point of operation or any associated danger zone.
- Repairing electrical circuits.
- Cleaning, repairing, and maintaining machinery with moving parts.
- Cleaning jammed mechanisms.
- Removing or bypassing a guard or other safety device.

Lockout equipment is located on the west wall of hallway 1130 in the Biomass Processing Facility; the northwest entrance of the Harvest, Storage and Transportation Building; and the northeast entrance of the Biomass Storage and Pretreatment Building.

Lockout/Tagout Locks Color Code

Building	Location	Color Code
Biomass Storage and Pretreatment Building	Northeast exterior door	Almond
Biomass Storage and Pretreatment Building	Fine particle biomass preparation lab	Orange
Harvest, Storage and Transportation Building	Northwest exterior door	Green
Biomass Processing Facility	Hallway 1130	Blue
Biomass Processing Facility	Hallway 1140	Red
Biomass Processing Facility	Room 1142	Yellow
Biomass Processing Facility	Room 2002	Purple

Application of Lockout Device

1. Prepare for shutdown. Notify employees that are affected by the shutdown of your intentions.
2. Shutdown the equipment or machine.
3. Machine or equipment isolation. All necessary energy isolation devices must be used so the machine or equipment is isolated from all energy sources.
4. Application of lockout device. Apply device so that all hazardous energies cannot be turned on without removal of lockout device. As a rule use one lockout device for each person performing work on the equipment or machine.
5. Stored energy. All potentially hazardous stored or residual energy shall be rendered safe.

6. Verification of isolation. Prior to the start of work on machines or equipment verify all energy sources have been de-energized and isolated.

Release from Lockout

1. Inspect the work area to ensure nonessential items have been removed and that machine or equipment components are operationally intact.
2. Inspect the work area to ensure all employees have been safely positioned or removed. Notify all employees that will be affected that the lockout device will be removed.
3. Remove the lockout device. Only the person who applied the device may remove it.

BCRF User Responsibilities

1. Complete the Electrical Safety and Lockout/Tagout training course offered by EH&S.
2. Develop written LOTO procedures.
3. Notify contractors of LOTO procedures.

Safeguarding Mechanical Hazards

The Occupational Safety & Health Administration (OSHA) requires that one or more methods of machine or equipment guarding shall be provided to protect employees from mechanical hazards. Examples of hazardous mechanical hazards include rotating parts, nip points, and saws. During periodic inspections, EH&S will evaluate work areas for mechanical hazards. Safeguards must meet these minimum requirements:

- Prevent contact. The safeguard must prevent hands, arms, and any other part of a worker's body from making contact with dangerous moving parts. A good safeguarding system eliminates the possibility of the operator or another worker placing parts of their bodies near hazardous moving parts.
- Secure. Workers should not be able to easily remove or tamper with the safeguard, because a safeguard that can easily be made ineffective is no safeguard at all. Guards and safety devices should be made of durable material that will withstand the conditions of normal use. They must firmly be secured to the machine.
- Protect from falling objects. The safeguard should ensure that no objects could fall into moving parts. A small tool, which is dropped into a cycling machine, could easily become a projectile that could strike and injure someone.
- Create no new hazards. A safeguard defeats its own purpose if it creates a hazard of its own such as a shear point, a jagged edge, or an unfinished surface which can cause a laceration. The edges of guards, for instance, should be rolled or bolted in such a way that they eliminate sharp edges.

- Create no interference. Any safeguard, which impedes a worker from performing the job quickly and comfortably, might soon be overridden or disregarded. Proper safeguarding can actually enhance efficiency as it can relieve the worker's apprehensions about injury.

When safeguards must be removed the mechanical hazard must be locked out according to ISU lockout procedures. Guards must be replaced before the mechanical hazard is released from lockout.

Personal Protective Equipment

BCRF User Responsibilities

Each supervisor shall perform a written Personal Protective Equipment (PPE) Assessment in their work area to determine if hazards are present or likely to be present which may require the use of PPE. The supervisor shall then select and have each affected employee use the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment. Each supervisor must verify that the hazard assessment has been performed with written documentation including the area evaluated, the person performing the assessment, and the date of the assessment. EH&S's PPE Assessment satisfies the OSHA requirement for written hazard assessment documentation.

Minimum Facility Attire and PPE Requirements

- Visitors: safety glasses in research bay, laboratories, or processing areas.
- Employees in research bays: safety glasses, closed-toed shoes, and long pants.
- Employees in laboratories: lab coats, safety glasses, closed-toed shoes, long pants, and gloves when appropriate.

Electrical Safety

Energized parts of an electrically powered device that an employee may be exposed to must be de-energized before the employee works on or near them. All de-energized electrical parts must be locked out in accordance with ISU lockout procedures. Equipment that is connected by a plug does not need to be locked out if the plug is removed from the outlet and under the exclusive control of the person performing service or maintenance.

In special cases employees may be allowed to work on energized electrical parts. This is allowed if the BCRF can demonstrate that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Only qualified persons are allowed to work on energized equipment. A qualified person is a person who has the following knowledge and skills:

- The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
- Ability to determine the nominal voltage of exposed live parts.
- Proper clearance distances specified in OSHA 1910.333 (c) for the voltage to which they will be exposed.

Qualified persons must be capable of working safely on energized equipment and be familiar with the proper use of personal protective equipment, insulation and shielding materials, and insulated tools.

Housekeeping

Proper housekeeping must be practiced at all times. Poor housekeeping can create life safety and fire hazards. Each user at the BCRF is responsible for proper housekeeping in their areas and contributing to the housekeeping of common areas.

Housekeeping Guidelines

- Corridors must always remain free of obstructions or impediments.
- Exit doors, including the floor area on both sides of the exit door, must be kept clear and accessible at all times.
- Clear access shall be maintained at all times to all fire extinguishers, fire alarms, fire hoses, and other emergency equipment.
- Maintain three feet of clear access in front of electrical panels.
- Oil, paint, and grease-soaked rags and combustible shavings must be placed in the proper waste containers and disposed of properly.
- Empty boxes, cartons, packing materials, loose papers, and other combustible materials must not be allowed to accumulate.
- Fire doors, stairways, aisles, exits and work areas must be kept clear and clean.
- Storage is not permitted closer than 18 inches below the level of sprinkler heads.

Fall Prevention

OSHA Fall Protection Standard is designed to prevent workers from falling off, into, or through working levels and to protect individuals from being struck by falling objects.

The [ISU Fall Protection Guidelines](#) require that individuals exposed to a potential free-fall greater than four feet must receive fall protection training and implement proper fall prevention methods. All fall protection equipment must meet or exceed the appropriate American National Standards Institute standard and equipment must be visually inspected for defects prior to each use. Defective components must be removed from service.

Areas where fall protection may be needed include, but are not limited to ramps, walkways, holes, formwork, leading edge work, unprotected sides and edges, roofing work, wall openings, construction, and other walking/working surfaces. Fall protection can be provided through the use of guardrails, safety nets, personal fall arrest systems, and other devices or systems.

Contractors, staff, or students implementing fall protection equipment shall have thoroughly assessed fall protection rescue plans for every possible scenario, including equipment and people needed to perform the rescue. The BCRF assistant director and emergency response personnel should review the written rescue plans.

Chains and Hoists

Hoist Maintenance and Inspection

Chain hoists are durable and long lasting; yet require regular maintenance (inspection, cleaning, and lubricating) per the manufacturer recommendations. Chains should be kept clean and rust free. Depending on the use, bearings should be oiled once or twice a year. Oiling and cleaning will require dismantling, and once clean, they should be greased. Hoists that slip should be tagged “out of order.” The hoist may be repaired, if possible. Chains that are worn, kinked, or stretched should be replaced.

It is the responsibility of the hoist owner/user to train operators and to designate inspection and maintenance personnel. Such training programs are designed to provide information for compliance with any Federal, State, or Local Code requirements and the instructions provided by the manufacturer of the hoist.

Periodic inspections include visual, hands-on examinations by designated personnel documenting the inspection in writing to provide the basis for a continuing evaluation of the hoist and its components.

Confined Space Entry

To prevent unnecessary injuries or loss of life at the BCRF, all confined space entries must be performed in accordance with the OSHA Permit-Required Confined Spaces Standard, 29 CFR 1910.146. BCRF personnel and users will follow the required elements outlined in the [Confined Spaces Manual](#) or equivalent.

The following confined spaces have been identified at the BCRF:

- Catch basin
- Dosing tank
- Septic tank

- Underground water vault
- Waste water land application tank

BCRF Personnel Responsibilities

BCRF personnel must follow the requirements in the [Confined Spaces Manual](#).

Chemical Hygiene

Safety Data Sheets

Each user at the BCRF is responsible for placing a SDS for every hazardous chemical used in SDS binders. The SDS binders for research bay operations are located on the east wall of each research bay. The SDS binders for laboratory operations are located on the west wall of each laboratory. At least annually, users should evaluate the SDS binders and remove SDS for chemicals no longer used.

Chemical Inventories

Each user at the BCRF is responsible for maintaining a [chemical inventory](#). These should be representative of the types and general amounts of chemicals present in BCRF facilities. Annually log into the [EH&S chemical inventory system](#) with your ISU username and password and update the inventory.

Proper Labeling of Chemicals

All chemical or biological containers in the laboratory must be labeled in order to ensure hazard information is readily available to employees, visitors, and emergency response personnel. Containers must be labeled with:

- Proper chemical or common name of contents in English. Chemical formulas, symbols, or acronyms are not acceptable. Mixtures or solutions must include a list of constituents and their concentrations.
- Signal words (i.e., danger and warning) and/or associated hazard(s), (e.g., eye irritant, corrosive, biohazardous, radioactive, etc.)
- Labels must include the project's PI or supervisor responsible, project group name or identifier, and date opened.

Additional information such as dates received, prepared, or opened; storage location; and owner or user of the material should also be included.

Procedures for the Safe Use of Chemicals

- Know the hazards associated with the materials you are using (review labels and SDS).
- Know the locations of safety equipment such as emergency shower, eyewash, fire extinguisher, fire alarm, and emergency phone numbers.
- Avoid working alone.
- Do not eat, drink, smoke, use tobacco, chew gum, or apply cosmetics in areas where laboratory chemicals are used or stored.

- Do not store food items or cosmetics in areas where laboratory chemicals are used or stored.
- Confine long hair and loose clothing when working with chemicals.
- Wear closed-toed shoes at all times. Sandals and perforated shoes are not allowed.
- Wear appropriate PPE including eye protection, lab coat, and gloves.
- Do not smell or taste chemicals.
- Handle and store laboratory glassware with care. Any cracked or damaged glassware must be disposed of in cardboard boxes labeled “broken glassware” and placed in the satellite accumulation area.
- Do not use mouth suction for pipetting or starting a siphon.
- Keep work areas clean and uncluttered with chemicals and equipment properly labeled and stored.
- Always wash hands and other exposed skin after chemical use and when exiting the lab.
- Do not leave potentially hazardous chemical processes unattended.
- Conduct all processes that may result in the release of toxic vapors, fumes, or dust within the fume hood.

Safe Storage of Chemicals

Below are some general guidelines for the safe storage of chemical and biological materials:

- Store materials according to manufacturer’s specifications in a designated location.
- Ensure that all stored containers are in good condition, closed, and properly labeled. Store all hazardous materials in containers, in cabinets, or on shelving compatible with the associated hazard or material.
- Segregate chemicals by hazard class (e.g., flammable liquids, organic acids, oxidizers, etc.). Chemicals may be stored alphabetically only within hazard class.
- Use secondary containment for all chemical and biological materials to prevent release into the environment.
- Secure all storage shelves and cabinets to prevent tipping.
- Ensure that storage locations are dry, adequately vented, and away from heat sources.
- Chemicals should be stored below a height of five feet.

Additional requirements for specific hazardous materials may be obtained from the SDS, container label, SOP, or by contacting EH&S at (515) 294-5359.

Safety Practices for Specific Hazards

Biohazardous Materials

Biohazardous materials are of biological origin and may cause harm to humans, domestic or wild animals, or plants. Biohazardous materials may not be brought onto any part of the BCRF site without approval of EH&S and the BCRF. When planning to use these materials contact EH&S at (515) 294-5359.

Compressed and Liquefied Gases

Compressed and liquefied gases pose significant chemical and physical hazards to BCRF users. Guidelines for the use of compressed gases are as follows:

- Only trained personnel shall use compressed and liquefied gases.
- Ensure gas cylinders and Dewar flasks are secured, away from heat sources, and capped when not in use.
- Ensure hazardous gases (fire or health rating 3 or 4) are stored in a ventilated cabinet or enclosure.
- When moving or transporting a gas cylinder, hard-toed shoes are required.
- Use an appropriate hand truck or cart to transport gas cylinders and Dewar flasks (do not drag or roll), ensure the valve protection caps are in place, and handle only one container at a time.
- Ensure proper maintenance and use of regulators, manifolds, and safety valves.
- Always wear safety goggles when performing any operation with compressed or liquefied gases. Additional protection may be required based on the gases used (e.g., face shield, insulated gloves, chemical resistant gloves, and/or an apron).
- After assembly of a gas supply system, test all connects using a soapy water solution or a sampling device able to detect the gas. Periodically retest the system if leaks are suspected. Refer to the [Gas Cylinder Safety Guidelines](#) if a leak is detected.

Corrosives

Corrosives react at the point of contact to cause eye or tissue damage. Corrosives include acids and bases and other chemicals such as phenol. Guidelines for the use of corrosives are as follows:

- Use splash goggles and heavy weight gloves resistant to the chemical used and its concentration. A face shield, resistant apron, and boots may also be appropriate depending on the work performed.
- Slowly add acids or bases to water. Never add water to concentrated acids or bases.
- Segregate acids from bases.
- Segregate inorganic and organic acids.

- Segregate oxidizing acids (nitric, perchloric, and chromic) from all other materials.
- An eyewash station must be present in the laboratory. A safety shower must be available within 10 seconds travel time from working area.
- Appropriate neutralizing agents for spill cleanup should be available in adequate quantities.
- Calcium gluconate gel must be available wherever hydrofluoric acid is used. This gel is used to treat skin exposure and can be obtained by contacting Occupational Medicine at (515) 294-2056. Seek medical treatment for exposure to hydrofluoric acid.
- Polyethylene glycol (PEG 300) must be available wherever phenol is used. PEG 300 is used to treat skin exposure and is available through Chemistry Stores at (515) 294-0203. Seek medical treatment for exposure to phenol.
- Perchloric acid use may result in the formation of explosive perchloric acid salts. Perchloric acid procedures must only be performed in approved laboratory fume hoods.

Dust

Dust particles are created when a solid material is crushed, ground, or sanded. Dust can enter the lungs or be ingested. Once airborne, dust is hazardous to all that may accidentally breathe it. It is the responsibility of workers to establish best practice guidelines for controlling exposure to dust to eliminate or greatly reduce the potential risk of injury and illness. Workers may use a dust mask or respirator to reduce their exposure to airborne dust.

Years of dust accumulation on equipment, pipes, floors, ducts, and other areas can lead to a combustible dust environment. Dust explosions are generally catastrophic in nature, resulting in loss of lives, severe structural damage, and are often devastating to the community. Guidelines for recognizing and understanding combustible dust hazards:

- Conduct general facility wide appraisals of dust explosion possibilities on a periodic basis.
- Conduct internal and external audits in order to identify potential explosion hazards.
- Staff and users need to identify explosion hazards through job hazard analyses.
- Pay particular attention to dust collection systems and other areas not in plain view during the assessment

Flammables and Combustibles

Flammable materials have a flash point of less than or equal to 37.8°C (100°F). Combustible materials have a flash point greater than 37.8°C. Vapor from these materials can reach remote ignition sources, causing flashback fires. Guidelines for the use of flammables and combustibles are as follows:

- Isolate ignition sources including hot surfaces, electrical equipment, and static electricity from flammable or combustible materials.
- Store flammable liquids in safety cans where container quantity exceeds four liters (approximately one gallon).
- Store flammable liquids in a flammable storage cabinet when total quantity in a laboratory exceeds 40 liters (approximately 10 gallons).
- Store flammables and combustibles away from oxidizers and strong acids.
- Store flammable liquids requiring cool/cold storage in refrigerators/freezers manufactured for that purpose. Modification of general-purpose (domestic) refrigerators or freezers for flammable liquid storage is NOT permitted.
- Ensure proper bonding and grounding when transferring flammable liquids from a container or drum.

Organic Peroxides

Organic peroxides are highly flammable and may react with organic material resulting in fires or explosions. Organic peroxides are extremely sensitive to heat, friction, shock, and light, as well as to strong oxidizing and reducing agents. In addition, organic peroxides may destabilize with age, contamination, or improper storage to become self-reactive. Common laboratory organic peroxides include benzoyl peroxide, butyl peroxide, and lauroyl peroxide. Guidelines for the use of organic peroxides are as follows:

- Mark containers with date received. Dispose of by the expiration date listed on the container label, within one year of purchase, or within six months of opening.
- Use organic peroxides away from organic materials such as paper and wood.
- Strictly adhere to manufacturer's use and storage instructions. Refrigeration and/or hydration may be required.
- Avoid operations that may concentrate organic peroxides (e.g., distillation, extraction, or crystallization)

Oxidizers

Oxidizers may react with organic materials resulting in fires or explosions. Common laboratory oxidizers include perchloric and nitric acids, sodium and ammonium nitrates, and hydrogen peroxide. Guidelines for the use of oxidizers are as follows:

- Use away from chemicals and organic materials such as paper and wood.
- Store in secondary containment away from all other chemicals.
- Ensure oxidizers used in organic reactions are completely spent/deactivated prior to placing in sealed containers.

- Deactivate residues according to the laboratory's standard operating procedure before discarding empty container.

Peroxide Forming Chemicals

Peroxide forming chemicals react with oxygen to form peroxides. Impact, heat, or friction can trigger peroxide explosions. Peroxide forming chemicals include ethyl ether, tetrahydrofuran, isopropyl ether, and potassium metal. Refer to the [Potentially Explosive Chemicals: Guidelines for Safe Storage and Handling](#) manual for a representative list of peroxide forming chemicals. Guidelines for the use of peroxide forming materials are as follows:

- Affix warning labels to containers and record dates received, opened, and tested.
- Dispose of peroxide forming chemicals at or before the expiration date marked on the container. To retain chemicals beyond the expiration date, test for peroxide concentration following the procedure in [Peroxide-Forming Chemicals Brochure](#).
- Never handle deformed containers or those with crystal formation. Contact EH&S for proper disposal.

Exposure Assessment and Medical Examinations

Occupational Medical Surveillance

ISU employees and students who work with hazardous chemicals or hazardous biological or physical hazards (noise, high heat, vibration, etc.) on a regular basis (at least once per week) must complete a Hazard Inventory for Occupational Medical Surveillance at the beginning of their employment. The Hazard Inventory can be downloaded from the EH&S web site at www.ehs.iastate.edu/forms/hazardinventory.pdf. This form must be reviewed and signed by a supervisor then submitted to EH&S for review.

Following receipt of the Hazard Inventory by EH&S, personnel with workplace hazards requiring medical monitoring are sent a questionnaire titled "Hazard Information Request." This questionnaire enables the individual to further evaluate the extent of potential exposure to the regulated hazards. Supervisors are expected to discuss the questionnaire with their employees before returning it to EH&S. EH&S uses this information to determine the need for enrollment in the Occupational Medicine Program or other monitoring program.

Exposure Assessments

If there is reason to believe that a hazard exists or may develop in the workplace, ISU employees or BCRF users may contact EH&S to perform initial environmental monitoring when:

- An employee exhibits signs or symptoms of exposure to a chemical.

- There is reason to believe that the level of employee exposure to a hazardous chemical exceeds permissible exposure levels.

EH&S may make recommendations for corrective actions or alternative procedures based on the results of monitoring. Each BCRF user is responsible for ensuring that the recommended corrective actions are followed. Additional and/or periodic monitoring can be conducted in order to establish the effectiveness of the corrective actions.

Safety Equipment

Eyewash Fountains

Three feet of unobstructed area must be maintained around eyewash fountains. Eyewash fountains must be located within 10 seconds of where corrosives, hot liquids, or other eye irritating materials (e.g., formaldehyde) are used or stored. Ensure that eyewash fountain locations are marked with a sign (typically green/white, available from EH&S) posted at eye level above the fountain. BCRF personnel should flush eyewash fountains monthly. Record monthly flushings on the “Safety Equipment Test Record” tag attached to the eyewash. For signs, tags, or assistance with installation of an eyewash station, contact EH&S at (515) 294-5359.

Fire Extinguishers

Ensure that fire extinguishers are unobstructed and locations are marked with a red/white “fire extinguisher” sign posted at eye level above the device. Annual extinguisher tests performed by EH&S are documented on a tag attached to the extinguisher. For signs, tags, or assistance with installation of an appropriate fire extinguisher, contact EH&S at (515) 294-5359. Annual Fire Safety and Extinguishers training is required for all BCRF personnel.

First Aid Kits

A properly stocked first aid kit shall be available to BCRF personnel and users. A list of recommended contents can be found in the [Iowa State University First Aid Guidelines](#).

Flammable Safety Cabinets

Flammable safety cabinets are storage cabinets, typically metal, manufactured to isolate flammable materials from a fire that occurs in the laboratory. Safety cabinets are required for storage of flammable liquids in laboratories with aggregate quantities greater than 40 liters (approximately 10 gallons) and are available for purchase through safety equipment suppliers.

Flammable Safety Cans

Flammable safety cans are containers, typically metal, with self-closing spouts and integral flame arresters used to store flammable liquids in single container quantities greater than four liters (approximately 1 gallon). Safety cans must be properly labeled and are available for purchase through safety equipment suppliers.

Glass Disposal

Glass will not be discarded in the dumpster but will be collected by EH&S for recycling. **All** empty chemical containers (glass and plastic) will be collected.

Glass disposal procedures for BCRF:

1. When placing an item in the bucket, remove the lid then replace the lid when done. The lid would not need to be tightly secured unless the bucket is full.
2. Do not further break laboratory glassware to make it fit into a bucket.
3. Empty reagent bottles need to be placed whole in the satellite accumulation area.
4. If a bucket fills before the end of the month, please contact EH&S at (515) 294-5359 for a replacement container.
5. EH&S will remove and replace the buckets.

Laboratory Fume Hoods

Fume hoods are designed to protect personnel by containing chemical and radiological contaminants. Fume hoods also provide a physical barrier to chemicals and their reactions. Refer to the [Laboratory Hood Manual](#) for additional information.

Laboratory Refrigerators and Freezers

Refrigerators and freezers used for flammable liquid storage must be manufactured for that purpose. Modification of general-purpose (domestic) refrigerators/freezers for flammable liquid storage is NOT permitted. General-purpose refrigerators/freezers must be labeled to prohibit storage of flammable materials (e.g., Caution: Do Not Store Volatile Materials in This Box).

Laboratory refrigerators and freezers must not be used to store food or beverages intended for human consumption. Affix an appropriate label to the refrigerator/freezer door (e.g., Caution: For Chemical Storage Only, No Food or Drink).

Safety Showers

Ensure that safety showers are accessible within 10 seconds of work areas and are maintained with at least three feet of unobstructed area. Safety shower locations are marked with a sign (typically green/white, available from EH&S) posted at eye level below the shower. Safety showers are inspected and flushed annually by Facilities Planning and Management (FP&M) at (515) 294-5100.

Spill Kits

Equipment for use in containing and cleaning up spilled hazardous wastes is stored at the BCRF. The following table lists the equipment and materials that should be stored and maintained on site for use in cleaning up chemical spills:

Materials/Equipment	Quantity	Purpose	Location
Standard industrial absorbents	Minimum of 2 bags	For small spills of oil solvents, aqueous materials. Do not use for acids or caustics unless first neutralized.	All research buildings
Broom and dust pan	At least one each	Clean up of spill residue	All buildings
Coveralls	Various sizes and quantities	Clothing protection	Various locations
Boots	1 pair per assigned employee, if needed	Foot protection	Variable
Gloves: Neoprene, Nitrile, Latex, etc.	More than 10 pairs More than 2 boxes	Hand protection	All research buildings
Telephones	Various	Communications	Various locations
Flashlights	Various	Emergency vision	Various locations

Hot Work

This program establishes written procedures for hot work with the goal of preventing fires. Hot work operations include tasks such as welding, brazing, cutting, grinding, or soldering that create heat, sparks, and hot slag.

Scope: This program applies to all hot work activities in BCRF facilities. BCRF users must have a hot work program that complies with National Fire Protection Association Code 51B or must follow ISU's Hot Work Program.

Hot Work Guidelines

- A permit must be obtained from a Permit Authorizing Individual (PAI) before beginning hot work activities. PAI's are employees who have completed Hot Work Permit Training and who have been authorized to issue permits by a supervisor. The BCRF assistant director is authorized to issue hot work permits.
- All flammable and combustible materials should be removed that are within 35 feet of the hot work area. Do not ignore less obvious combustibles such as dust, fibers, lint, insulation, etc.
- If it is not feasible to remove combustible materials, protect combustibles through the use of fire-resistant or fire-retardant barriers and post a fire watch.
- Passages to combustibles can be subtle. Any openings or cracks in the walls, floors, or ducts are potential travel passages for sparks, heat, and flames.
- Ensure that all processes involving flammable liquids that could potentially release ignitable vapors are shut down prior to hot work.
- Do not shut down automatic sprinkler protection to perform hot work. Instead protect individual sprinkler heads from heat in the area of hot work.
- Ensure that there is a fully charged operating fire extinguisher nearby.

Hot Work Contractors

Hot work contractors are required to follow the rules outlined above and must obtain a hot work permit from the BCRF assistant director before performing any work on site. The hot work permit is valid for one day only.

Waste and Recycling

Hazardous Waste Generator Status

According to the Environmental Protection Agency's (EPA) definition, the BCRF is currently categorized as a conditionally exempt small quantity generator (CESQG) of hazardous waste. This is due to the BCRF historically generating less than 100 kilograms of hazardous waste per month (40 CFR 261.5). To maintain CESQG status, the BCRF cannot produce more than 100 kilograms of hazardous waste per month or no more than one kilogram of acute hazardous waste per month. In order to determine monthly CESQG status, EH&S is scheduled to pick up the BCRF's unwanted materials on a monthly basis. EH&S must be contacted to perform a waste generation evaluation anytime there is a change to a process involving waste or there is a new process generating waste.

BCRF personnel and users can reference the [Waste and Recycling Guidelines](#).

An EH&S training course on waste and recycling is required for all BCRF personnel and users. This course covers the guiding principles for waste management, definition of waste, and the proper procedures for managing waste according to ISU policy and EPA requirements.

Waste Removal and Recycling Procedures

EH&S is responsible for the collection, treatment, and disposal of all waste, including lamps and ballasts, generated by the BCRF. The BCRF is currently on a monthly collection schedule. Special collections may be scheduled online by using the [Waste Removal Form](#).

Waste Removal and Recycling Contacts

Waste removal and recycling questions may be directed to Jason Terry at (515) 294-3409 or jmterry@iastate.edu.

Air Emissions

Emission sources require special permitting or exempting according to the Clean Air Act and the Iowa Administrative Code Chapter 22. There are several sources of emissions at the BCRF. These sources cannot be removed or modified without notifying EH&S. Additionally EH&S must be notified of plans for new equipment installations that produce emissions.

The BCRF is currently operating under a facility exemption provided in the Iowa Administrative Code, IAC 567.22.1(2)(kk). Per the exemption, the BCRF must maintain records of emissions from exempted sources on a 12-month rolling average in order to demonstrate actual emissions are below exemption limits.

Current equipment included in the exemption and up-to-date emission calculations must be maintained by BCRF personnel and must be available for inspection by the Iowa Department of Natural Resources.

Air Emissions Contacts

Air permitting and exemption questions may be directed to Kaylin Contag at (515) 294-2009 or contagk@iastate.edu.

Training

Training Procedures

This training plan has been developed based on needs assessments of employee work assignments. All training is available through EH&S. BCRF personnel may attend sessions at the EH&S facility or attend one of the regularly scheduled daylong course sessions. There is no charge to BCRF personnel for attending regularly scheduled classes at EH&S or for taking online courses through the EH&S Learning Center.

Employee supervisors are responsible for ensuring that their employees receive safety training. Supervisors may request special access on the EH&S web site to view staff training history from EH&S.

New BCRF employees will be asked to complete a Client Profile through the EH&S Learning Center. They must have an ISU ID number.*

Registration for classes at EH&S may be done through the [EH&S web site](#).

EH&S Training Contact Information

Jordan Harding, Safety Contact for the BCRF

Phone: (515) 294-6749

Email: jharding@iastate.edu

Steve Couchman, Training Coordinator

Phone: (515) 294-8338

Email: rebook@iastate.edu

Clayton Chapman, Training Specialist

Phone: (515) 294-6523

Email: chapmc11@iastate.edu

Online Registration: <https://training.ehs.iastate.edu/IowaSU/site/>

*You must have an ISU ID number to log into the system. This is located on the front of your ISU Card. Employees of the Memorial Union, Research Park, USDA, Iowa State Center, and other affiliates may also be eligible to receive an ISU Card. Please see the [ISU Card Office web site](#) for more information.

Safety Training Courses

Employees Working in the BCRF Research Bays and Outbuildings

Core Required Courses

- Electrical Safety and Lockout/Tagout (required every three years)*
- Safeguarding Mechanical Hazards (required every three years)*
- Fire Safety and Extinguishers Training (required annually)*
- Hot Work Permit Guidelines (required every three years)
- Laboratory Safety: Core Concepts (required every three years)*
- Shop Safety Fundamentals (required every three years)*
- Emergency Response Guide video (required every three years)*
- Personal Protective Equipment (required every three years)*

Required Courses (for those using this equipment)

- Confined Space Awareness and Entrant Training (required every three years for individuals working around or in designated confined spaces)
- Forktruck Safety Training (required every three years)*
- Laboratory Safety: Compressed Gas Cylinders and Spill Procedures (required every three years)*
- Scissors and Boom Lift (required every three years)
- Tractor Training Guidelines (required annually)*

Recommended Courses

- CPR, First Aid, and AED
- Laboratory Safety: Autoclaves and Biological Safety Cabinets (required every three years)*
- Laboratory Safety: Conducting Laboratory Inspections (required every three years)
- Office Ergonomics*

Employees with Occasional Duties at the BCRF

Core Required Courses

- Fire Safety and Extinguishers (required annually)*
- Personal Protective Equipment (required every three years)*

Recommended Courses

- CPR, First Aid, and AED
- Office Ergonomics*

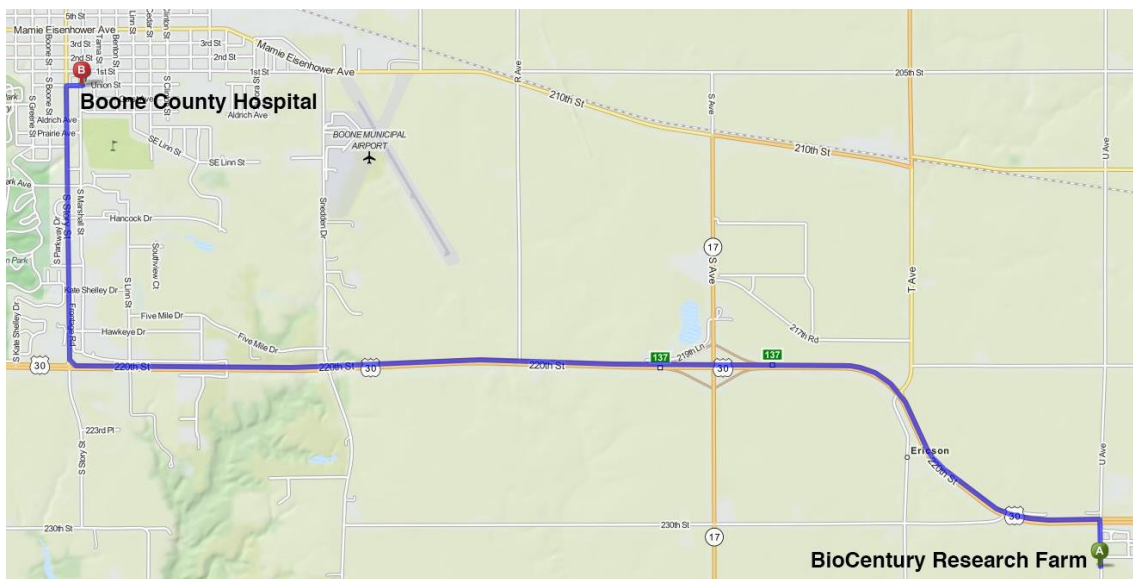
*Denotes a training offering available at the EH&S Learning Center, www.ehs.iastate.edu.

Appendix A

Driving Instructions to Boone County Hospital

Boone County Hospital is located at 1015 Union Street, Boone, Iowa 50036-4821.

1. Start out going north on U Avenue (0.2 miles)
2. Turn left onto US-30 West. Continue to follow US-30 West. (5.6 miles)
3. Turn slight right onto South Story Street. (1.4 miles)
4. Turn right onto Union Street. (0.08 miles)
5. 1015 Union Street is on the left.



Appendix B

List of Acronyms and Abbreviations

BCRF — BioCentury Research Farm

CESQG — Conditionally exempt small quantity generator

EH&S — Environmental Health & Safety

EPA — Environmental Protection Agency

FP&M — Facilities Planning and Management

ISU — Iowa State University

LOTO — Lockout/tagout

OSHA — Occupational Safety & Health Administration

PAI — Permit Authorizing Individual

PI — Principle investigator

PPE — Personal protective equipment

SDS — Safety data sheet

SOP — Standard operating procedure

