

Kegonsa Research Campus Safety Policy and Procedures Manual

University of Wisconsin-Madison
Stoughton, WI 53589

Center for Nano Technology
Physical Sciences Lab
Synchrotron Radiation Center

July 1, 2000
Current Revision: April 23, 2012b



IMPORTANT PHONE NUMBERS (608 Area Code)

Emergency (Fire - Police - Ambulance) 911

KRC Safety Manager	2157
KRC Safety Manager Cell Phone	9-225-2761
SRC Accelerator Operator on Duty	2002
SRC On-Duty Cell Phone	9-575-6152
SRC Operator/Administrative Office	9-877-2000
University Hospital Poison Center	9-262-3702
UW Department of Police and Security	9-264-2677
UW Safety Department	9-265-5000
UW Radiation Safety Department	9-265-5000

		Internal	Outside
Mike Fisher	SRC Building Manager	2148	9-877-2148
Rick Keil	SRC Operations Manager	2176	9-877-2176
Bruce Neumann	KRC Safety Manager	2157	9-877-2157
Gary Anderson	PSL Building Manager	2312	9-657-2830
Joseph Bisognano	Director, SRC	2163	9-877-2163
Farshid Feyzi	Director, PSL	2250	9-877-2250

Maintenance and Non-Emergency Phone Numbers

UW Physical Plant (CARS*)	9-263-3333
Stoughton Fire Department	9-873-7218
UW Police and Security**	9-264-2677

* **Notify Gary Anderson when CARS is called.**

** **Notify Bruce Neumann when UW-Police or 911 are called.**

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World Wide Web Safety Resources

<http://www.src.wisc.edu/safety/index.htm>

Kegonsa Research Campus Safety Web-safety manual, safety booklet and safety links

<http://www.fpm.wisc.edu/chemsafety/Guide/guide/METAFPMCS.html>

University of Wisconsin Chemical Safety and Disposal Guide-reference on disposal procedures for hundreds of chemicals

<http://www.uwsa.edu/oslp/ehs/>

University of Wisconsin System Environmental Health and Safety Homepage-includes links to many safety resources

<http://www.ilpi.com/msds/>

Links to thousands of MSDS's and MSDS information

<http://www2.fpm.wisc.edu/safety/>

University of Wisconsin Safety Department-radiation, general, chemical

<http://www.src.wisc.edu/users/index.htm>

online "SRC Experiment Form"-formerly known as "SRC Information on Hazardous Materials"

<http://www.osha.gov>

Homepage of OSHA-US Occupational Safety and Health Administration

Chapter 1. General Principles for Working at the KRC

Policy

The KRC will conduct its work in a manner that will ensure the health and safety of its personnel and Users, preserve the environment, and comply with university, municipal, state, and federal regulations.

The *KRC Safety Policies and Procedures Manual* meets the Chemical Hygiene Plan of the “Lab Safety Standard” and fulfills requirements of the “Hazard Communication Standard”. This safety manual is written to meet compliance with Wisconsin Governor's Executive Order #194, and as part of compliance with Wisconsin State Statute 101.055 and Wisconsin COM 32 “Public Employee Safety and Health”.

1. General Rules

The KRC will comply with all university, municipal, state, and federal regulations concerned with the health and safety of personnel and Users, and with the protection of the environment. Two main applicable safety regulations being the “Hazard Communication Standard”, or the “Right-to-Know” Law, and the “Laboratory Safety Standard”.

The KRC will investigate any safety or health concerns raised by personnel or Users. Solutions to concerns will be a priority.

All personnel, Users, and visitors (including outside-contract workers) will be required to adhere to KRC Safety Policies and Procedures.

Within the state of Wisconsin, the Department of Commerce (DOC) has generally adopted OSHA regulations, with a few modifications. DOC is responsible for regulating occupational health and safety at state of Wisconsin agencies, including the University of Wisconsin. Occupational health and safety regulations for State of Wisconsin agencies are listed under DOC 32 “Public Employee Safety and Health”.

2. Responsibilities

The Director of each facility of the KRC is responsible for

- Providing support for institutional safety practices.
- Enforcing required safety regulations.

Each facility's Safety Officer is responsible for

- Working with administrators to develop and implement appropriate safety policies and procedures.
- Helping supervisors develop precautions and adequate facilities.
- Seeking ways to improve the safety program.
- Knowing the current legal regulations concerning health, safety, and environmental protection.
- Seeing that appropriate audits are maintained.

The KRC Safety Specialist is responsible for

- Ensuring that KRC personnel and Users know and follow the safety rules, that protective equipment is available and in working order, and that appropriate training has been provided.
- Providing regular KRC safety inspections including routine inspection of emergency equipment.
- Know the current legal regulations concerning health, safety, and environmental protection.
- Determining the required level of protective apparel and equipment.
- Ensure that KRC facilities and training for use of any material being ordered are adequate.
- Taking action, when authorized, to correct hazards when identified during KRC safety inspections.
- Notifying the facility Safety Officer and appropriate KRC personnel or Users of safety violations.
- Enforcing KRC safety policy and procedures, when authorized.
- Resolving KRC worker health and safety concerns.
- Assisting all facilities of the KRC with their safety programs.

Supervisors are responsible for

- Safety practices of personnel under their direction.
- Knowing and enforcing safety regulations within their staff.
- Considering safe procedures when making operational or management decisions.
- Stressing the importance of safety to workers under their direction.
- Safety training for specific job and/or tasks.

Users and KRC personnel are responsible for

- Safety and health concerns for their work.
- Knowing and complying with KRC Safety Policies and Procedures.
- Ensuring that their operation is safe, and without hazard to fellow Users, KRC personnel, and workers.

Temporary workers (including contract workers) are responsible for

- Safety and health concerns for their work.
- Ensuring that their operation is safe, and without hazard to fellow workers, Users, and KRC personnel.
- Temporary workers must be supervised by SRC personnel or User while at the SRC and be provided with a copy of the SRC New User Orientation and Safety Booklet.

3. Hazard Communication Standard

The “Hazard Communication Standard”, adopted under COM 32.50, requires the hazards of all hazardous materials at the worksite be evaluated, and that information concerning their hazards be made available to personnel. This information is to be provided by means of a comprehensive hazard communication program, which is to include container labeling and other forms of warning, Material Safety Data Sheets (MSDS) and personnel safety training.

4. Laboratory Safety Standard

The “Laboratory Safety Standard”, adopted under COM 32.50, regulates hazards to personnel engaged in the laboratory use of hazardous chemicals. To comply with the standard, a Chemical Hygiene Plan, personnel safety training, hazard identification, record keeping, and medical surveillance are conducted to ensure Permissible Exposure Limits (PEL’s) are not exceeded for hazardous laboratory chemicals.

Chapter 2. The Kegonsa Research Campus Safety Committee

1. Purpose

The Kegonsa Research Campus safety committee serves as an advisory committee concerned with safety, health, and environmental protection. From its meetings, recommendations are made for addressing hazards and improving safety. Proposed safety policies are presented by the KRC Safety Specialist to the KRC Safety Committee. Once approved, safety policies are announced to affected personnel through staff meetings, memos, and/or training.

2. Membership

KRC Safety Committee

- PSL Safety Officer
- CNTech Safety Officer
- SRC Safety Officer
- KRC Safety Specialist (advisor)

3. Method Of Operation

The safety committee meets routinely, although special sessions will be called if necessary. Minutes are kept and distributed to members of the safety committee and interested personnel.

Chapter 3. The Kegonsa Research Campus

The Kegonsa Research Campus is a branch of the University of Wisconsin. The Kegonsa Research Campus (KRC) contains the Center for Nano Technology (CNTech), Physical Sciences Laboratory (PSL), and the Synchrotron Radiation Center (SRC).

Synchrotron Radiation Center

1. Design

The SRC will have:

- An appropriate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air.
- An adequate, well-ventilated Chemical Storage Building.
- Laboratory fumehoods and sinks.
- Other safety equipment including emergency eyewashes, emergency showers, first aid supplies, and fire-fighting equipment.
- Arrangements for waste disposal.
- An interlock system so as to prevent entry to the Aladdin vault during injection.
- An elevator connecting the main floor to the lower level.
- A machine shop for SRC and User work.
- An emergency lighting system that automatically turns on during power failures.
- Paging system with battery backup during power loss.

The floor plan of the SRC can be found in the “*Appendix*”. The main floor of the SRC consists of offices, a Control Room, Mechanical Equipment Room, and Air Handling Room. The lower level contains the Aladdin vault, Machine Shop, Chemical Room, Electronics Area, and preparation areas.

Accommodations for handicapped staff and visitors, including restrooms, doorways, and work areas will be made to fulfill requirements of the “Americans with Disabilities Act” (ADA).

All heating, ventilating and air conditioning systems to be designed, installed, maintained, and operated so as to provide a safe and healthful environment for work, as established in ILHR Chapter 64 "Heating, Ventilating and Air Conditioning".

2. Maintenance

Safety-related equipment undergoes continual appraisal and is modified if inadequate. Personnel should bring to the attention of the facility safety officer or KRC Safety Specialist unsafe equipment. Modifications to unsafe equipment shall be performed within a reasonable period. “Safety Reports” may be issued until compliance is achieved.

3. Usage

The work and experiments conducted and their scale must be appropriate to the SRC facility, and especially, to the quality of ventilation. Experimenters are asked to submit plans for all experiments to ensure that engineering controls are adequate for the intended purpose.

4. Ventilation

Ventilation within the SRC experiment areas, offices, and machine shop is required to comply with COM 32 and ILHR 64.

General Laboratory Ventilation Should

- Provide a source of air for breathing.
- Not be relied on for protection from toxic substances released into the laboratory.
- Ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day.
- Direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building.
- Make-up air must be supplied as air is exhausted.

Fumehoods

- A laboratory hood is provided for Users and personnel if they work with chemicals.
- Ensure that the hood is turned "on" prior to use. Hoods shall not be used if the hood fan is inoperative. The hood fan must remain on at all times when chemicals are present.
- A visual signal or light will indicate the fan is not working.
- At the labeled mark, airflow velocity is 100 linear feet per minute, an adequate rate for work with most chemicals.
- Fume hoods are preferred as a first line of protection in handling hazardous materials. Personal protective apparel must still be used, however.
- Fumehood exhaust is directed outside the building.

Beamline Ventilation

- Ensure that all connections are secure before use, and that an air flow is present.
- An exhaust system is provided at each beamline for local ventilation to the exterior of the building.
- All mechanical pump exhausts, after passing through an oil mist filter, are to be connected to the ventilation system.
- When using gas cylinders which may create a health or physical hazard, local exhaust ventilation must be used to adequately capture an accidental or catastrophic leak of the cylinder contents. The use of gas cabinets is a preferred method of ventilation control.

Emergency Exhaust System

- An emergency exhaust system is used to rapidly evacuate contaminated vault air. It consists of one hundred percent exterior makeup air. See Chapter 13 for emergency ventilation procedures.
- When the emergency exhaust system is used upon release of a hazardous gas, personnel must be evacuated from the building.

Modifications

Any alteration of the ventilation system will be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate.

Performance

The SRC general ventilation rate is normally adequate general ventilation if local exhaust systems such as fumehoods are used as the primary method of control. Fume hoods, operated at one hundred linear feet per minute, are adequate for safe fumehood use of most chemicals.

Quality

- General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas.
- Airflow into and within a fumehood should not be excessively turbulent.
- Hood face velocity will be adequate (typically 100 lfm sash fully open).

Evaluation

- Quality and quantity of ventilation will be evaluated on installation, regularly monitored, and reevaluated whenever a change in local ventilation devices is made.
- Air quality tests will be performed routinely to ensure toxic materials are not maintained in workers' breathing zones.

Special Ventilation Areas

Cntech Cleanrooms

- Exhaust air from the Process Cleanroom fumehoods should pass through scrubbers before release into the atmosphere.

SRC Machine Shop

- Ventilation in the Machine Shop will provide uncontaminated air for breathing, and air exhausted will be replaced by make-up air in compliance with COM 32 and ILHR 64.
- An overhead exhaust will provide local ventilation during welding activities.

SRC Electric Shop

- Each workbench in the SRC Electric Shop has a local exhaust for removal of soldering fumes.

SRC Ultrasonic Baths

- The ultrasonic baths have movable local exhausts for removal of solvent vapors.

Physical Sciences Laboratory

1. Design

The PSL is a Butler-type structure that is divided into two main sections. The front section of the building consists of administrative offices, conference rooms, CAD area, electronics shop, computer room, library, and first aid room. The rear half of the building consists of a mechanical shop, UHV and leak detection area, stockroom, large and small assembly bays, and user support areas. A five ton overhead traveling crane is located in the mechanical shop. The front and rear sections of PSL are separated by a fire wall.

The PSL will

- have an appropriate general building ventilation system.
- have a first aid room and supplies. Safety equipment, including, emergency eyewashes, showers and fire-fighting equipment is located throughout the facility.
- have a storage shed, specific for the storage of flammable and combustible solvents and waste flammable and combustible materials, separate from the main building.
- have storage areas for full and empty gas cylinders, separately for flammable and nonflammable gases.
- storage area for collecting surplus nonflammable materials prior to shipment to UW Madison.
- have a chemical disposal program.
- have a material recycling program.
- have an emergency lighting system.
- a fire alarm system with automatic reporting to the UW Police and Security. The system will use a combination of break stations, smoke detectors and heat detectors.
- have a paging system with a battery backup during power loss.
- have, where flammable liquids are used, flammable liquid storage cabinets.
- have, where hazardous chemicals are used, a fume hood for safe handling of those chemicals.
- have exhaust fans located at each end of the high bay.

The floor plan of the PSL can be found in the “*Appendix*”. The front of PSL consists of offices, while the rear consists of a machine shop, stockroom, welding shop and electronics shop.

Accommodations for handicapped staff and visitors, including restrooms, doorways, and work areas will be made to fulfill requirements of the “Americans with Disabilities Act”(ADA).

All heating, ventilating and air conditioning systems to be designed, installed, maintained, and operated so as to provide a safe and healthful environment for work, as established in ILHR Chapter 64 "Heating, Ventilating and Air Conditioning".

2. Maintenance

Safety-related equipment undergoes continual appraisal and is modified if inadequate. Personnel should bring to the attention of the facility safety officer or KRC Safety Specialist unsafe equipment. Modifications to unsafe equipment shall be performed within a reasonable period. "Safety Reports" may be issued until compliance is achieved.

3. Usage

The work and projects conducted and their scale must be appropriate to the facility. For work conducted at the SRC facility, the work and experiments conducted and their scale must be appropriate to the SRC facility, and especially, to the quality of ventilation. Experimenters are asked to submit plans for all experiments to ensure that engineering controls are adequate for the intended purpose.

4. Ventilation

General Building Ventilation

- General building ventilation should provide an adequate rate of air exchanges per hour.
- General building ventilation should provide a source of air for breathing.
- General building ventilation should not be relied upon for protection from toxic substances released into the laboratory atmosphere.
- General building ventilation should ensure that lab air is continually replaced, preventing increased concentrations of toxic substances during work periods.

Fume Hoods

- An adequate, well ventilated fume hood is stationed in the Vacuum Test Area.
- An adequate, well ventilated fume hood is stationed in the Welding Area.

Spray paint Booth

An adequate, well ventilated and filtered spray paint booth is located adjacent to the PSL Receiving Area.

Inspection Room

An adequately ventilated room for parts inspection is available.

Modifications

Any alteration of the ventilation system will be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate.

Performance

The PSL general ventilation rate is normally adequate general ventilation if local exhaust systems such as fumehoods are used as the primary method of control. Fume hoods operated at one hundred linear feet per minute are adequate for safe fumehood use of most chemicals.

Quality

- General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas.
- Airflow into and within fumehoods should not be excessively turbulent.
- Hood face velocity will be adequate (typically 100 lfm).

Evaluation

- Quality and quantity of ventilation will be evaluated on installation, regularly monitored, and reevaluated whenever a change in local ventilation devices is made.
- Air quality tests will be performed routinely to ensure toxic materials are not maintained in workers' breathing zones.

Center For Nano Technology

1. Design

The CNTech will

- have an appropriate general building ventilation system.
- have a first aid room and supplies. Safety equipment, including, emergency eyewashes, showers and fire-fighting equipment is located throughout the facility.
- have a storage shed, specific for the storage of flammable and combustible solvents and waste flammable and combustible materials, separate from the main building.
- have storage areas for full and empty gas cylinders, separately for flammable and nonflammable gases.
- Storage area for collecting surplus nonflammable materials prior to shipment to UW Madison.
- have a chemical disposal program.
- have a material recycling program.
- have an emergency lighting system.
- a fire alarm system with automatic reporting to the UW Police and Security. The system will use a combination of break stations, smoke detectors and heat detectors.
- have a paging system with a battery backup during power loss.
- have, where flammable liquids are used, flammable liquid storage cabinets.
- have, where hazardous chemicals are used, a fume hood for safe handling of those chemicals.

The floor plan of the CNTech can be found in the “*Appendix*”. The offices are located in Trailers 9023 and 9025, with the Beamline and Process cleanrooms located in the Aladdin vault and SEM cleanroom in the CNTech Annex.

Accommodations for handicapped staff and visitors, including restrooms, doorways, and work areas will be made to fulfill requirements of the “Americans with Disabilities Act”(ADA).

All heating, ventilating and air conditioning systems to be designed, installed, maintained, and operated so as to provide a safe and healthful environment for work, as established in ILHR Chapter 64 "Heating, Ventilating and Air Conditioning".

2. Maintenance

Safety-related equipment undergoes continual appraisal and is modified if inadequate. Personnel should bring to the attention of the facility safety officer or KRC Safety Specialist unsafe equipment. Modifications to unsafe equipment shall be performed within a reasonable period. "Safety Reports" may be issued until compliance is achieved.

3. Usage

The work and projects conducted and their scale must be appropriate to the facility.

4. Ventilation

General Building Ventilation

- General building ventilation should provide an adequate rate of air exchanges per hour.
- General building ventilation should provide a source of air for breathing.
- General building ventilation should not be relied upon for protection from toxic substances released into the laboratory atmosphere.
- General building ventilation should ensure that lab air is continually replaced, preventing increased concentrations of toxic substances during work periods.

CNTech Cleanrooms

- Exhaust air from the Process Cleanroom fumehoods will be passed through scrubbers before release into the atmosphere.

Modifications

Any alteration of the ventilation system will be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate.

Performance

The CNTech general ventilation rate is normally adequate general ventilation if local exhaust systems such as fumehoods are used as the primary method of control. Fume hoods operated at one hundred linear feet per minute are adequate for safe fumehood use of most chemicals.

Quality

- General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas.
- Airflow into and within the fumehood should not be excessively turbulent.
- Hood face velocity will be adequate (typically 100 lfm).

Evaluation

- Quality and quantity of ventilation will be evaluated on installation, regularly monitored, and reevaluated whenever a change in local ventilation devices is made.

Chapter 4. Chemical Procurement, Distribution, and Storage

Objective

Establishment of a standard operating procedure for the purchase, notification, usage and storage of hazardous materials to meet Wisconsin COM 32 "Public Health Safety and Health" and state and federal environmental protection regulations.

1. Procurement

If ordering hazardous materials for shipment to the KRC, notification is to be sent to the KRC Safety Specialist. Incoming chemicals will not be released for use until the KRC Safety Specialist has received notification.

Users are asked to submit a "SRC Experiment Form" at least one month prior to beginning work. Forms are located on the shelf beneath the SRC Staff and User mailboxes or may be submitted electronically from the SRC website or the SRC SafetyWeb page. Include a diagram of any gas handling system (with gas cabinet if using a hazardous gas), and a detailed explanation of how each chemical will be used (including storage, quantity brought to SRC, quantity used in each run, placement into the chamber, general handling, and disposal).

Each hazardous materials used or stored at the KRC must have a Material Safety Data Sheet. KRC maintains files of the MSDS's and ensures that they are accessible to all personnel. Please contact the KRC Safety Specialist to determine if you need to submit a MSDS.

When hazardous materials arrive at the KRC Receiving Area, they are placed in one of the two chemical cabinets in the Receiving Area. A copy of the purchase order will be placed on the cabinet door. An "ok" on the purchase order indicates it may be picked up. A "not ok" indicates that it will be held until released by the KRC Safety Specialist.

2. Hazardous Material Storage

SRC Hazardous Material Storage

The SRC Chemical Storage Building is located outdoors, on the south side of the SRC. It may be opened using the SRC main door key.

All SRC research chemicals not in current use are to be stored in the SRC Chemical Storage Building. The SRC Chemical Storage Building is not to be used as a preparation area.

Separate areas for storage of flammable and nonflammable hazardous materials are provided. The first level is for nonflammable, corrosive and oxidizing gases. Oxidizing, reducing, corrosive and nonflammable liquids and solids are also stored on the first level. The second level is for flammable gases, solids and liquids. Oxidizers are to be stored in the nonflammables area. Examples include oxygen cylinders. SRC aerosol spray paints and lubricants are to be stored in the SRC flammable liquids cabinet. Peroxide-forming chemicals (ethers, tetrahydrofuran) should be used quickly and not allowed to be stored for lengthy periods of time. All peroxide-forming chemicals will be disposed if they have a shelf-life of more than two years.

Liquid and solid chemicals are to be labeled with NFPA stickers.

Stored hazardous materials will be examined periodically for deterioration and container integrity. An inventory will be posted on each cabinet or shelf. Chemicals will be disposed if container integrity is questionable.

Safety equipment located in the SRC Chemical Storage Building include: first aid equipment, emergency shower, emergency eyewash, fire extinguisher, chemical gloves, bottle carriers, and chemical goggles.

A maximum of 60 gallons of Class I, II, and III flammable and combustible liquids may be kept in each cabinet. Each cabinet storing flammable chemicals will be grounded.

Storage areas for large full and empty gas cylinders of nonflammable gases are provided.

PSL Hazardous Materials Storage

Separate areas for storage of flammable and nonflammable hazardous materials are provided. Oxidizers are to be stored in the nonflammables area. Examples include oxygen cylinders. Peroxide-forming chemicals (ethers, tetrahydrofuran) should be used quickly and not allowed to be stored for lengthy periods of time. All peroxide-forming chemicals will be disposed if they have a shelf-life of more than two years.

Liquid and solid hazardous materials are to be labeled with NFPA decals.

Stored chemicals will be examined periodically for deterioration and container integrity. Chemicals will be disposed if container integrity is questionable.

First aid equipment, emergency shower, emergency eyewash, and fire fighting equipment are located in the main bay of the PSL and in the PSL first aid room. Other safety equipment, such as gloves and chemical goggles, are to be found in areas where work with chemicals is done.

PSL aerosol spray paints are to be stored in the PSL flammable liquids cabinet adjacent to the spray paint booth. Commercial cleaning chemicals should be kept in the appropriate storage cabinet in the maintenance service area.

A maximum of 60 gallons of Class I, II, and III flammable and combustible liquids may be kept in each flammable liquids cabinet. Each cabinet storing flammable chemicals will be grounded.

Hazardous materials storage areas at PSL include flammable liquid cabinets adjacent to the spray paint booth and cabinets in the Vacuum Test Area. Flammable liquid cabinets are located outside the PSL Stockroom. Cabinets and a storage area for storage of cutting oils, gearbox oils, and other combustible liquids are maintained.

A storage shed for flammable and combustible solvents and waste is provided. A storage area for collecting surplus nonflammable materials prior to shipment to UW Madison is provided.

Storage areas for full and empty gas cylinders with separation of flammable and nonflammable gases is provided.

Cntech Chemical Storage

All CNTech research chemicals not in current use are to be stored in the SRC Chemical Storage Building or CNTech Process Cleanroom. Separate areas for storage of flammable and nonflammable hazardous materials are to be maintained. CNTech aerosol spray paints and lubricants are to be stored in flammable liquids cabinets. Peroxide-forming chemicals (ethers, tetrahydrofuran) should be used quickly and not allowed to be stored for lengthy periods of time. All peroxide-forming chemicals will be disposed if they have a shelf-life of more than two years.

Liquid and solid chemicals are to be labeled with NFPA stickers.

Stored hazardous materials will be examined periodically for deterioration and container integrity. An inventory will be posted on each cabinet or shelf. Chemicals will be disposed if container integrity is questionable.

First aid equipment, emergency shower, emergency eyewash, and fire extinguishers are located within the SRC Chemical Storage Building and within the CNTech Process Cleanroom. Other safety equipment, such as gloves, bottle carriers, and chemical goggles, are to be found throughout the facility.

A maximum of 60 gallons of Class I, II, and III flammable and combustible liquids may be kept in each cabinet. Each cabinet storing flammable chemicals will be grounded.

A storage area for full and empty gas cylinders of nonflammable gases is provided.

3. Distribution

SRC Building

Other than immediate-need chemicals, all chemicals for use at the SRC are to be stored in the SRC Chemical Storage Building. Other than immediate-need chemicals, all chemicals for use at the PSL and CNTech are to be stored in secure chemical cabinets.

Stocks of ethanol, acetone, Oakite, deionized water, Citranox, Ridoline and common inorganic acids are kept in the SRC Chemical Room. Stocks of solvents and cleaning agents are kept in the PSL Vacuum Test Area area. Stocks of solvents, photodevelopers and photoresists are kept in the CNTech Process Cleanroom.

Small amounts of solvents, in NFPA labeled squeeze bottles, may be stored outside of flammable liquid cabinets.

Spray paints and other flammable aerosols are to be stored in flammable liquids cabinets.

Containers of chemicals hand carried from the SRC Chemical Storage Building are to be transported securely in a bottle carrier. Gas cylinders are not to be carried in a bottle carrier. Bottle carriers are located in the SRC Chemical Storage Building and SRC Chemical Room.

Areas of storage are to be maintained in an organized manner.

SRC Chemical Room

The SRC Chemical Room is located on the lower level of the SRC, in the northeast corner, adjacent to the Machine Shop. It is designated a Class B intermediate hazard laboratory. Under this classification, a maximum of 26 gallons of Class I, II, and IIIA flammable and combustible liquids may be stored, of which 13 gallons may be Class I. This amount requires half of the quantity be stored in safety cans or cabinets.

Permanent storage of User chemicals is not allowed in the SRC Chemical Room. Do not store chemicals in the fume hood. Non-SRC stored chemicals will be subject to immediate disposal. All locations will be inspected daily, and all unauthorized materials will be disposed.

Stocks of solvents and inorganic acids are maintained for use.

Use only the appropriate cleaning agent in each ultrasonic baths.

Work with chemicals at SRC is to be performed in the Aladdin Vault or the SRC Chemical Room and/or its fume hood. All chemicals are to be identified by name, owner, and date. Chemicals not in compliance will be disposed. Work with chemicals at PSL is to be performed in the Vacuum Test Area fume hood. Work with chemicals at CNTech is to be performed in the Process Cleanroom or SRC Chemical Room fume hood.

It is the user's responsibility to clean up one's mess. Individuals not complying with this rule will not be allowed to use the work area.

Aladdin Vault

- Under no circumstances will there be long-term storage of chemicals in the vault. All chemicals and gas cylinders are to be stored in the SRC Chemical Storage Building.
- Small amounts of solvent may be stored in labeled squeeze bottles in the vault. Small amounts of chemicals for immediate use may be maintained in the vault.

CNTech Cleanrooms

The CNTech cleanrooms are located on the lower level of the SRC, within the Aladdin vault, and in the CNTech Annex.

- Chemicals necessary to experiments are to be stored in appropriate cabinets. Flammable liquids are to be separated from oxidizers and corrosives.
- No chemicals are to be stored in doorways, transfer ports, or on the landing.
- An inventory of chemicals contained within the Cleanrooms is posted at the entrances, and updated regularly. Chemicals must be identified with NFPA labels.
- A fire extinguisher, fire alarm, and Emergency Stop button are contained within. Two emergency exits from each room shall be kept clear at all times.
- First aid equipment, emergency shower, and emergency eyewash are maintained.

The CNTech Process Cleanroom is designated a Class B intermediate hazard laboratory. Under this classification, a maximum of 90 gallons of Class I, II, and III A flammable and combustible liquids may be stored, of which 45 gallons may be Class I. This amount requires half of the quantity be stored in safety cans or cabinets.

PSL Vacuum Shop

- Stocks of solvents and inorganic acids are maintained for use.
- Use only the appropriate cleaning agent in the ultrasonic baths.
- Chemicals are to be stored in appropriate cabinets. Flammable liquids are to be separated from oxidizers and corrosives.
- First aid equipment, emergency shower, and emergency eyewash are maintained.

KRC Machine Shops

- Oils, lubricants, cutting solutions and all other hazardous materials for use in KRC machine shops are to be stored in appropriate cabinets or other means of storage.
- Areas of storage are to be maintained in an organized manner.
- Chemicals are to be stored in appropriate cabinets. Flammable liquids are to be separated from oxidizers and corrosives.
- First aid equipment, emergency shower, and emergency eyewash are maintained.

Chapter 5. Environmental Monitoring

1. Chemical Monitoring

Regular instrumental monitoring of airborne contaminants is not usually practiced in the KRC, but is appropriate when testing or redesigning hoods or other ventilation devices or when a highly toxic substance is stored or used regularly. A gas detector will be used when appropriate. The UW Safety Department will be called in for air monitoring when needed.

The UW Safety Department examines and certifies all fumehoods at the KRC annually.

2. Noise Monitoring

Regular instrumental monitoring of noise levels is not usually practiced in the KRC, but is appropriate when testing or redesigning equipment that could pose a noise hazard. The UW Safety Department will be called in for noise monitoring when needed.

3. Radiation Monitoring At SRC

SRC Users and personnel will wear radiation badges to measure absorbed doses of radiation. Area monitors measure radiation at regular intervals throughout the Aladdin vault. The SRC Radiation Safety Specialist will monitor radiation levels following modifications to the ring or existing radiation shielding.

The individual in charge of SRC radiation safety and badge distribution is the SRC Radiation Safety Specialist (RSS).

Each new SRC User or employee is assigned a radiation badge upon check-in. The badges may be obtained only through an SRC Operator.

All personnel in the SRC vault must wear a radiation badge. The only exceptions are visitors and subcontract employees working for very short periods of time. Visitors and subcontract employees must be escorted by KRC staff who are wearing a radiation badge, the visitor's names will be logged along with the beam energy and current, and the tour guide must take a pocket dosimeter along on the tour and log the beginning and ending dosimeter readings.

Radiation badges are changed promptly on the first of each quarter.

Records of radiation badge doses are posted on the lower level of the SRC on the bulletin board located between the men's and women's restrooms.

Chapter 6. Housekeeping and Inspections

1. Cleaning

Floors are to be cleaned regularly. Empty boxes and crates are to be disposed of. Waste cans in areas of chemical storage are to be emptied daily. Red waste cans, located throughout the KRC, are intended for disposal of solvent contaminated materials.

Place appropriate materials in the recyclable materials containers. Aluminum foil and copper gaskets are to be placed in the appropriate containers. Paper should be thrown in the "Office Paper for Recycling" baskets. Refer to the "KRC Waste Disposal and Recycling Guide" in the *Appendix* for the proper route for recyclable materials. Containers for recyclable materials are distributed throughout KRC.

Users and personnel are responsible for cleaning their messes in the SRC Chemical Room, SRC Cleanroom, CNTech cleanrooms, User work areas, and all other areas of KRC.

Dispose of empty chemical containers in the trash cans of chemical storage or use areas. Ensure that there is no chemical remaining in the container. Do NOT place empty chemical containers with recyclable materials.

Never reach into a waste can.

All discarded glassware is to be placed in the YELLOW cans marked "Deposit Glass Here". Glassware includes pipettes, broken glass, glass labware, etc. This does not include fluorescent light bulbs.

Small non-rechargeable alkaline batteries may be disposed of in the normal trash. Other waste batteries (lithium, NiCd, NiMH, silver oxide, lead) may be given to the KRC Safety Specialist for recycling or placed in a recycled battery bin.

Unwanted E-scrap [computer equipment, monitors, circuit boards, relays, switches, etc.] is not to be placed in normal trash. Many of these types of electronics equipment contain hazardous materials, for example, lead, cadmium, mercury, or chromium. These components may be given to the KRC Safety Specialist for proper routing or given to the KRC Stockroom for entry into the SWAP E-scrap recycling program.

Waste motor oil is collected and disposed separately from waste lab chemicals. Waste lubricating, penetrating, or machine tool gearbox oil is collected and disposed separately from waste lab chemicals. Waste mechanical pump oil is collected in carboys and disposed.

Empty aerosol spray cans may be disposed of in the normal trash. Aerosol spray cans still containing paint, lubricant, etc, should be routed for surplus. See the KRC Safety Specialist.

The "KRC Waste Disposal and Recycling Guide" may be found in the *Appendix*. The guide lists many items commonly disposed or recycled at KRC with the appropriate disposal/recycling procedure and a contact name for any questions.

KRC Sharps Policy

Sharps are objects that may cause lacerations or break the skin resulting in a potential exposure to infectious body fluids or injury to the body. Common examples found at KRC include razor blades, X-Acto knife blades, glass pipettes, broken glass, or needles.

What is the sharps disposal policy?

All sharps are to be separated from the normal trash stream. Sharps such as razor blades, knife blades, or glass pipettes are to be placed in the Sharps Disposal containers located in KRC buildings. This includes sharps contaminated with blood.

Safe work procedures

Don't reach into waste cans to empty them of their trash. Dispose of sharps immediately after using. Keep containers of sharps upright. Place sharps into appropriate waste container. Treat all sharps with universal precautions. Label sharps containers for disposal "Caution Sharps". When cleaning up a spill involving sharps, do not sweep the fragments or sharps into the dustpan or container by hand. Use a needle nose pliers, forceps, brush or broom.

What if I am injured by a sharp?

If you are injured by a sharp object, immediately wash the wound with hot soapy water. Flush the area for several minutes. Treat with first aid measures solely unless medical treatment is necessary. Notify your supervisor if medical treatment is necessary or if blood came into contact with an open cut or break in the skin caused by the sharp. Also notify your facility's safety officer to report an injury if medical treatment is received.

If an infectious microorganism in blood may have entered the body, a medical examination is required. Continued medical surveillance and/or a vaccination may result.

See Chapter 8 "*Occupational Exposure to Bloodborne Pathogens*" for procedures in cleaning blood spills.

2. Inspections

The KRC Safety Specialist will perform informal inspections of KRC chemical inventories, the SRC Chemical Storage Building, SRC Chemical Room, Aladdin vault, experiment equipment, KRC machine shops, and associated areas of the KRC regularly. Recommendations will be forwarded to each facility's safety officer.

Other inspections:

- The Stoughton Fire Department inspects the KRC biannually for fire code compliance.
- The fire alarms are to be tested once each month. Fire drills will be performed annually.
- The SRC interlock system is to be tested annually.
- First-aid equipment will be inspected weekly.
- The SRC elevator is inspected annually.
- Emergency eyewashes and emergency showers will be tested routinely.

- Fire extinguishers are inspected annually by the UW Safety Department.
- Fire extinguishers and fire alarms will be visually inspected once per month.

3. Passageways

Stairways and hallways are not to be used as storage areas. Storage space is provided to SRC Users within the vault. Other SRC storage space is available upon request from the SRC Associate Director-Research. Contact the appropriate facility manager for storage space at the PSL or CNTech.

Aisleways are to be indicated by black and white striped or solid white floor tape. Aisleways are to be cleared to the floor tape. Aisle widths are to be a minimum of 28 inches, while routes of travel during emergencies are to be at least 31 inches in width. Two different routes of passage from all areas must exist for emergency exit purposes.

Access to exits, emergency equipment, breaker panels, and utility controls must never be blocked. Any material blocking access to the above is subject to immediate disposal.

Exterior means of passage (sidewalks) are to be maintained and kept clear of snow.

Emergency lights and emergency exit signs will indicate routes for, and be adjacent to all emergency exits.

Chapter 7. Medical Program

1. Compliance With Regulations

Regular medical surveillance will be established to the extent required by regulations.

All medical records (accident reports, respirator training, etc.) will be confidential and on file for the duration of employment plus thirty years.

2. Routine Surveillance

Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable.

Anyone whose work requires wearing a respirator should consult a qualified physician annually. KRC will provide for an annual respiratory physical to ensure personnel who wear cartridge type respiratory protection are physically capable of doing so.

3. First Aid

First Aid and CPR training will be available to interested staff and users once per year.

First Aid kits are located throughout the KRC complex. A large First Aid Locker is located on the lower level of SRC. It contains a stretcher, crutches, and miscellaneous first aid supplies. Chemical Burn First Aid Kits will be located in lab areas where corrosive chemicals are handled. The PSL Emergency Equipment Locker is located near the central aisle of the high bay area. It contains a fire blanket, stretcher, and miscellaneous first aid supplies. A PSL First Aid Room is located in Room 48. This room is stocked with a stretcher, crutches, and miscellaneous first aid supplies.

The Stoughton Hospital Urgent Care Center is the nearest emergency room and is the responding emergency medical service for KRC.

For MEDICAL EMERGENCIES, dial 911 to obtain help.

A medical emergency is one in which a victim's life may be at risk from the injury. Immediate medical assistance is necessary.

- After verifying a medical emergency [i.e., heart attack, head injury, severe bleeding] shout for help. Do not enter the area if it poses any risk for you (i.e., electrical shock, toxic gas leak, etc).
- Send a co-worker to call 911. Give detailed information as to the injury and location of the emergency. Do not hang up until the dispatcher hangs up the phone. If a co-worker is not available, call 911 while assisting the victim.
- Stay with the victim until EMS arrives. First Aid (especially CPR) measures should be given only by trained individuals. If trained in first aid, please provide first aid assistance until professional help arrives.

KRC has volunteers who are Red Cross Certified in Cardiopulmonary Resuscitation and First Aid, and are capable of assisting victims until EMS arrives. Staff and Users interested in becoming certified in Cardiopulmonary Resuscitation and First Aid please contact the KRC Safety Specialist.

Saline wash bottles, adjacent to First Aid Kits, may be used to wash chemicals or irritants out of the eyes or off the skin. However, KRC recommends you also seek emergency medical attention. Medical gloves, splints, triangular bandages, stretcher, cold packs, gauze, and insect sting kits, and eye patches are located in the First Aid Room and Locker.

Emergency phone numbers are listed at the front of the safety manual.

4. Reporting Injuries

Definitions:

- Nonrecordable injury or illness: bruise, small cut, sliver, etc. that can be treated on-site with no medical treatment from a doctor or other medical personnel.
- Recordable injury or illness: one that requires outside medical treatment (stitches, cast, etc.) or continuing therapy (injured back, etc.).

Recordable injuries or illnesses are required by law to be documented by the employer. Nonrecordable injuries or illnesses are not. However, it is a useful tool for safety staff to keep track of minor injuries. If a trend of similar injuries is occurring, changes should be made to prevent future occurrences. Please let the KRC Safety Specialist know of all injuries or illnesses.

For KRC Staff:

Recordable injuries and/or illnesses are to be reported to the supervisor by completing a "Employee's Work-Injury and Illness Report". It is to be completed and submitted to the supervisor within 24 hours of the injury and/or illness. "Employee's Work-Injury and Illness Reports" may be obtained from the Personnel Office or the KRC Safety Specialist.

Occupational Safety and Health Administration (OSHA) Form 200 is to be completed and filed by each buildings safety officer annually. Form 200 documents the previous year's recordable injuries and illnesses in the workplace. OSHA Form 200 is posted during February of each year.

For KRC Users:

Recordable injuries and/or illnesses are to be reported to the KRC Safety Specialist by completing a "Safety Report". It is to be completed and submitted to the KRC Safety Specialist within 24 hours of the injury and/or illness. "Safety Reports" may be obtained from the facility safety officer or the KRC Safety Specialist.

Chapter 8. Occupational Exposure to Bloodborne Pathogens

1. Policy

The Bloodborne Pathogen Standard, adopted by Wisconsin COM 32 "Public Employee Safety and Health", was established to protect the health of personnel who could be reasonably anticipated as a result of performing their duties to face contact with blood or other potentially infected materials. KRC complies with the "Bloodborne Pathogen Standard" and has established procedures to protect applicable employees from exposure to bloodborne procedures. If personnel are exposed to a bloodborne pathogen, KRC adheres to UW-Madison's bloodborne pathogen exposure policy.

2. What is a Bloodborne Pathogen?

A bloodborne pathogen is a microorganism in blood or other infectious body fluids that can cause disease in people. Any body fluid that is visibly contaminated with blood must be considered as infected. The two of primary concern are HIV and Hepatitis B virus. At KRC, the primary potentially infectious body fluid is blood.

HIV, human immunodeficiency virus causes AIDS, a fatal disease. AIDS attacks the human immune system. Once people actually develop AIDS, which may take years after being exposed to HIV, their immune system cannot fight off disease. When people die from AIDS, they usually die from a disease their body could not defeat, like pneumonia or a type of cancer.

Hepatitis B virus is much more common than AIDS. Hepatitis B affects the liver and is fatal in a small number of cases. Once you contract Hepatitis B, you are at a much greater risk for possibly fatal liver diseases such as cirrhosis of the liver or liver cancer.

In an occupational setting, HIV and Hepatitis B may be transmitted to you by being stuck by an infected needle or other sharp instrument or direct contact between broken or chafed skin and infected blood. Hepatitis B may also be transmitted through contact with dried blood or surfaces that have been contaminated.

3. Who Needs to be Concerned About Bloodborne Pathogens at KRC?

Most people think of healthcare workers when concerns about exposure to bloodborne pathogens are discussed. But other occupations may be exposed to bloodborne pathogens. Law enforcement personnel, morticians, laundry personnel, corrections personnel, and maintenance personnel are all occupations where exposure could occur. At KRC, the only staff the "Bloodborne Pathogens Standard" applies to are the custodial staff. While exposure potential is greatly less than that of a healthcare worker, custodial staff may be exposed to bloodborne pathogens while cleaning bathrooms, mopping up a blood stain, or when emptying a trash can. All custodial staff must be made aware of the hazards involving bloodborne pathogens, how to prevent exposure, and what to do if exposed.

4. What Needs to Be Done By KRC?

Three things need to be done. Firstly, inform you about the hazard. Secondly, set up safe procedures. "Universal Precautions"-It means that workers are to treat all blood and other potentially infectious body fluids as if they are infected. Its the same type of precaution you follow with any possibly hazardous material. The point of universal precautions is to avoid direct contact with potentially infectious body fluids. Ways of following this philosophy are to always use protective apparel like gloves and eye protection, washing off skin immediately following potential exposures, and bandaging or covering open cuts, rashes or broken skin. And finally, establish an exposure plan.

5. Safe Work Procedures

General

Follow universal precautions-treat all body fluids as infected. Avoid direct contact, always wear protective gloves. If there is a possibility of a splash occurring during the clean-up, protective eyewear is required. Don't keep food or drink in work areas where a potential to exposure of body fluids exists. Don't eat, drink, apply makeup, smoke or use tobacco, or handle contact lenses in areas with exposure potential. Immediately wash all body surfaces exposed to body fluids with hot soapy water. If eyes are exposed to body fluids, flush the eyes with saline or use an emergency eyewash. Do not use hot soapy water to flush eyes. After cleaning up body fluids, wash off the protective gloves with hot water, then carefully remove the gloves, and wash your hands with hot soapy water.

Cleaning Up Body Fluids

Ensure that the area is kept clear of personnel while cleaning up the body fluid. You must wear protective gloves while cleaning up body fluid. If there is a chance of splashing, protective eyewear is required. If broken glass, metal, or other sharps are present, use a needle nose pliers, forceps, or brush and pan to dispose. Use common absorbents like paper towels or you may choose to use a Blood Spill Kit. Blood Spill Kits are located in all janitor closets, in the SRC First Aid Locker, and the PSL First Aid Room. Follow the directions on the container. Contain the spill by covering with paper towels and carefully pour 10% bleach solution around and on the spill. Take care not to splash the bleach. Remove the paper towels and repeat the process until all body fluid is removed. Ensure body fluid contaminated materials are placed immediately in a biohazardous waste bag. Do not allow the contamination to spread farther!

Disinfection Of Area

Once all visible body fluid is absorbed, the area of the contamination must be disinfected. HIV and Hepatitis B virus are easily killed by disinfection with a 10% bleach solution (one part bleach to 9 parts water). Let the disinfectant stand for ten minutes, then absorb the excess into a paper towel. Place these towels with the biohazardous waste.

Disposal

Clean and decontaminate any pails, mops, or other cleaning supplies that may have come into contact with the body fluid. Wash off gloves with hot water. Remove gloves or other contaminated clothing carefully to avoid contamination. Properly bag and dispose of as biohazardous waste any gloves, towels, or other materials that came into contact with body

fluids. The body fluid and contaminated absorbents must be properly bagged as biohazardous waste. All biohazardous waste must be shipped to the UW Safety Department.

6. What Do You Do If Exposed To Possibly Infected Body Fluids?

Immediately wash the area exposed to the potentially infected body fluid. Remember all body fluids are to be regarded as potentially infected. Use hot soapy water and flush the area for several minutes. If eyes are exposed to body fluids, flush the eyes with saline or use an emergency eyewash. Do not use hot soapy water to flush eyes.

Notify your supervisor if body fluids came into contact with an open cut, break in the skin, a skin rash, your mouth, nose, or eyes. All these areas are potential transmission sites.

If an infectious microorganism in body fluids may have entered your body, a medical examination is necessary. Continued medical surveillance and/or a vaccination may result.

Chapter 9. Protective Equipment

1. Policy

The KRC will make available protective equipment to its temporary workers, personnel, and Users to reduce the potential for physical injury and/or illness. The OSHA “Personal Protective Equipment Standard” is incorporated by reference in Wisconsin COM 32 “Public Employee Safety and Health”. To meet compliance, a workplace hazard assessment must be taken, appropriate equipment chosen for each hazardous task, and training provided by KRC to ensure that personnel are capable of using the personal protective equipment properly.

Respiratory protection equipment is discussed in Chapter 10 “*Respiratory Protection*”. Fall protection equipment is discussed in Chapter 37 “*Fall Protection*”. Hearing protection equipment is discussed in Chapter 39 “*Hearing Protection Plan*”.

2. Definitions

Back support belt- Protective device designed to reduce the stress imposed on one’s back while material handling. A back support belt is similar to the belt worn by weight lifters.

Cumulative trauma disorder- A disease of the musculoskeletal system produced by a gradual buildup of small amounts of damage over a long period of time as a result of repetitive motion or sustained posture.

Glasses- Eyewear worn to protect eyes from solid hazards, such as dust or flying debris. Safety glasses do not provide protection from splashing liquids. Safety glasses possess sideshields.

Goggles- Eyewear worn to protect the eyes from hazards such as dust, splashing liquids, or flying debris. Chemical goggles must have indirect venting to prevent liquids and solids from entering the goggle. Machine shop goggles often have pinhole ventilation on the sides, providing direct ventilation.

Musculoskeletal- Descriptive term referring to the combined muscle and skeletal systems.

Protective equipment- Such items as safety glasses, hard hats, protective footwear, gloves, hearing protection, goggles, filters, face shields, back-support belts, and lab aprons designed to reduce the potential for physical injury and/or illness. For KRC, protective equipment includes fire extinguishers, emergency eyewashes or showers, and first aid supplies.

Personal protective equipment (PPE)- Protective equipment specifically worn by the individual. It is designed to reduce the potential for physical injury and/or illness.

Protective footwear- Footwear designed to reduce the potential for foot injury due to falling or rolling objects, objects piercing the sole, or exposure to electrical hazard. Protective footwear, when mentioned in this manual, will be referring to steel toed shoes.

3. General Rules

Use of specific protective equipment may be prescribed in safe operating procedures, safety manuals, or by signs posted near a potentially hazardous operation, area, or piece of equipment.

The KRC will provide certain protective equipment, such as safety glasses, gloves, goggles, and lab aprons, to its temporary workers, personnel, and Users. This equipment may be found throughout the KRC: SRC Chemical Room, SRC Chemical Storage Building, Aladdin vault,

KRC machine shops, CNTech cleanrooms, PSL Spray paint Booth, or from the KRC Safety Specialist.

The KRC Safety Specialist and the KRC Stockroom will maintain an inventory of protective equipment, which may be checked out. This equipment includes gloves, safety glasses, goggles, hearing protection, hard hats, filtering facepiece respirators, and back support belts.

4. Responsibilities

KRC personnel, temporary workers, and Users are responsible for:

- Using protective equipment when it is prescribed or otherwise indicated in order to reduce the potential for physical injury and/or illness.
- Properly caring for the protective equipment that has been issued for personal use and notifying their supervisor or the KRC Safety Specialist immediately if the equipment is defective.
- Using protective equipment within the limitations and warnings of the manufacturer or the special instructions provided by the facility safety officer or the KRC Safety Specialist. See the Quick Selection Guide for Chemical Protective Clothing for hand protection recommendations.

The KRC Safety Specialist, facility safety officer and supervisors are responsible for:

- Evaluating the need for protective equipment and maintaining a supply of quality protective equipment for use.
- Ensuring that protective equipment is worn by those temporary workers, KRC personnel, and Users when prescribed or otherwise indicated in order to reduce the potential of physical injury and/or illness.
- Providing training on use, care, and any limitations of protective equipment that is issued.
- Approving the selection and acquisition of protective equipment not in stock or in need of replacement.
- Maintaining a respiratory protection program that meets DOC requirements.

5. Personal Protective Equipment

Safety gloves, glasses, goggles, aprons, etc., compatible with the required degree of protection for substances being handled are located in the SRC Chemical Storage Building, SRC Chemical Room, CNTech Process Cleanroom, and PSL Vacuum Test Area. Back support belts and hearing protection are provided. Protective equipment may also be checked out of the KRC Stockroom.

Safety Goggles and Glasses

- All goggles and glasses stocked for personnel use meet ANSI Z87.1-1989 for impact protection. Glasses are intended for use in machine shop or electric shop operations. Chemical goggles, indirect venting or nonventing, must be used when working with chemicals.
- Safety glasses must be worn while working in KRC machine shops or during activities where potential for an eye injury exists.

- Chemical goggles must be worn while working in the SRC Chemical Room and in all cases when handling chemicals. Do not use machine shop goggles when handling chemicals.
- It is very important that all personnel wear the appropriate protective eyewear when conducting hazardous operations, including but not limited to, machine shop work or when handling chemicals.
- Wearers of prescription safety glasses must wear side shields when conducting work where potential for flying object hazards exists.
- Detachable side shields may not be removed from safety glasses.
- A prescription safety glasses program exists for KRC employees. Contact the Personnel Office for details.

Aprons

- Aprons are recommended for protection when handling hazardous chemicals, in particular, corrosive chemicals. It is also advisable to wear an apron when handling solvents.

Hand Protection

- Gloves are provided as hand protection for a number of work activities. General work, chemical, welding, cryogenic and disposable gloves are provided for use.
- Cotton work gloves are provided for general labor and material handling. They may not be used for machine shop operations, cryogenic material work, or for handling chemicals. They are available throughout the KRC and in the KRC Stockroom.

Chemical gloves provided by the KRC include many types:

- Neoprene/latex gloves are a combination of synthetic rubber and natural rubber. They may be used when handling acids, caustics, and some alcohols and solvents.
- Silvershield gloves are made from a laminate material named Norfoil. They resist a wide range of toxic and hazardous chemicals. They are highly resistant to acids, caustics, and solvents.
- Latex gloves are made from natural rubber. Latex resists permeation of acids and caustics but should not be used when handling organic solvents.
- Nitrile gloves are made from synthetic rubber. They have excellent puncture and abrasion resistance. They are resistant to caustics, acids, and some organic solvents.
- Neoprene gloves are made from synthetic rubber. They may be used when handling acids, caustics, and some alcohols and solvents.
- Vinyl gloves, also known as PVC or polyvinyl chloride, are made of a plastic material that resists acids and alcohols but not petroleum solvents.

Before choosing a glove, consult a “Glove Chart” or the *Quick Selection Guide to Chemical Protective Clothing* in the KRC Stockroom or SRC Chemical Room. It is important that the appropriate chemical glove be worn when handling a chemical.

- Insulated gloves for working with cryogenic materials must be worn when handling any cryogenic material. Insulated gloves are located where dewars are stored.

- Welding gloves must be worn when conducting any welding operation. They may be found in the SRC machine shop and PSL Welding Shop.
- Vinyl or neoprene disposable examination gloves are commonly used by personnel to prevent contamination of samples or equipment. Disposable examination gloves are not intended for chemical immersion or extensive contact. Examination gloves may be used while cleaning a part if only very minimal exposure to a chemical occurs. Latex gloves may cause problems for those individuals who have a sensitivity to latex. For that reason vinyl or neoprene are the preferred types of examination glove.

Protective Footwear

SRC has established a protective footwear policy in compliance with Wisconsin public employee safety regulations. Wisconsin COM 32 requires “employees wear protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee’s feet are exposed to electrical hazards”. Protective footwear, when referred to in this manual, will be steel toed shoes which meet compliance with ANSI Z41-1991 “American National Standard for Personal Protection-Protective Footwear”, or if purchased before July 5, 1994, ANSI Z41.1-1967 “USA Standard for Men’s Safety-Toe Footwear”.

KRC employees must wear protective footwear while engaging in a task involving a foot hazard. Employees do not have to wear protective footwear during their entire shift, but must wear the protective footwear when a potential for foot injury exists. KRC strongly recommends Users wear protective footwear when engaging in tasks with a foot injury potential.

The “*HAZARD ASSESSMENT AND PPE REQUIREMENTS*” section of Chapter 9 of the *KRC Safety Policies and Procedures Manual* lists a number of tasks for which protective footwear is required to be worn by KRC employees.

The University of Wisconsin provides an annual allowance toward the purchase and/or maintenance of protective footwear. Contact the Personnel Department for information regarding the footwear allowance.

6. Hazard Assessment And PPE Requirements

Below are listed activities which are hazardous and require personal protective equipment. Activities not listed below which may pose a hazard to personnel should be evaluated by the supervisor, facility safety officer, or KRC Safety Specialist. The type and degree of hazard is evaluated, and personal protective equipment recommended for each activity is listed. Many activities below are interrelated, as are all work duties. For example, when painting a piece of metal, there is a potential for respiratory illness, musculoskeletal injury, or acute injury. One would need to examine this task from a material handling, general labor and painting job analysis. This is not a complete list of all activities at KRC, but is a listing of hazards present in many activities and personal protective equipment necessary to perform the work safely. Any task that is conducted should have hazards of the activity identified prior to beginning the work. After utilizing engineering controls and safe work practices, the proper protective equipment should be used by personnel.

Cleaning Chemical Spills (not-immediately hazardous spills only)

At KRC, cleaning chemical spills may occur; usually the spill is very small and not immediately hazardous to personnel. However, hazards are present, and injuries and illness may occur if the proper personal protective equipment is not used. Possible injuries and illness cleaning up a spill at KRC are of an acute type, generally skin exposures by solvent or possibly corrosive agent. Burns, rashes or dermal irritations are the likeliest injuries, although severe eye injuries may result if eye protection is not used. Please refer to specific MSDS's for complete descriptions. The risk factor is possible, with severity of injuries or illness being temporary, with the exception of eye injuries. There are chemicals that may pose long term problems if the exposure is very large or is a chronic exposure, which should not be the case when cleaning a chemical spill at KRC. See also LABORATORY/CHEMICAL.

- chemical goggles
- chemically resistant gloves
- chemically resistant apron or full suit
- chemically resistant footwear
- face shield
- respirator (if necessary)

Construction

Construction activities are frequent at KRC. There are a number of injuries that may result from hazards workers are exposed to while engaged in this activity. Chronic exposure to excessive noise levels will damage hearing permanently, although only temporary damage to hearing should result from acute excessive noise levels. Injuries from misuse of or malfunctioning power equipment range from minor to severe. Injuries to the musculoskeletal system are possible if proper material handling procedures are not followed. As with all welding activities, the potential for damage to eyesight is possible, especially for unprotected persons viewing the arc. A high potential for injury exists when work is conducted at heights above six feet. Possible injuries ranging from broken bones to paralysis or death may result. The risk level is high, with severity of injuries ranging from minor to severe (paralysis or death). See also WELDING AND SOLDERING and MAINTENANCE.

- eye protection (type applicable to activity)
- face shield (during grinding or blasting)
- protective footwear
- hard hat
- cold weather/rain gear (during inclement weather)
- hearing protection (if 8 hour TWA exceeds 85dBA)
- welding protection (gloves, apron, helmet)
- back support belt (if necessary)
- body harness (for fall protection)

Electrical

Other than electrocution or burns resulting from electrical shock, minor injuries are likely. Work conducted on powered systems must follow lockout/tagout procedures, so the potential of electrocution is reduced. There still exists risks of exposure, and likely injuries would be burns, shock, or [unlikely] coma or death. Other injuries generally would result from associated tasks, such as cutting wire, soldering or moving equipment. Injuries would be of an acute type, unless

damage to the eye(s) results. Injuries to the musculoskeletal system are possible if proper material handling procedures are not followed. The risk factor following normal procedures is low, but risk exists when working with electrical equipment. Injuries would likely be temporary, other than exposures to high voltage, which may result in death.

- safety glasses with side shields
- protective footwear
- lineman's gloves or high-voltage disconnect pole (accessible in emergency)

General Labor

With general labor, workers are exposed to various hazards. While the majority of hazards would be minor, injuries due to falls, electrocution, hazardous atmospheres or chemicals, or power tools likely would be serious. Injuries to the musculoskeletal system are possible if proper material handling procedures are not followed. The likeliest injuries include lacerations and punctures, cumulative trauma disorders, eye injuries, or foot injuries. These incidents would be acute and of minimal risk if proper procedures and protective equipment are used. See also MAINTENANCE, MATERIAL HANDLING and CONSTRUCTION.

- respiratory protection (if necessary)
- eye protection (type applicable to activity)
- protective footwear
- gloves (type applicable to activity)
- hard hat (if necessary)
- back support belt (if necessary)
- hearing protection (if 8 hour TWA exceeds 85 dBA)
- cold weather/rain gear (during inclement weather)
- body harness (for fall protection)

Janitorial

The risk factor is minor for janitorial activities. Injuries due to acute exposure of cleaning chemicals, eye injuries, punctures, and cumulative trauma disorders are the primary hazards. Injuries to the musculoskeletal system are possible if proper material handling procedures are not followed. Most hazards are due to acute exposures, and injuries will be temporary. Cumulative trauma disorders are chronic and no cure may be found. Injuries are probable but will generally be temporary. See also MAINTENANCE and MATERIAL HANDLING.

- eye protection (type applicable to activity)
- gloves (type applicable to activity)
- cold weather/rain gear (during inclement weather)
- protective footwear
- back support belt (if necessary)

Laboratory/Chemical

When working with chemicals, risk factors are very high. Even when following proper procedures and wearing personal protective equipment, injuries or illness may result. Burns, rashes or dermal irritations are the likeliest injuries, although severe eye injuries may result if eye protection is not used. Illnesses range from nausea and dizziness to respiratory distress or poisoning. Please refer to specific MSDS's for complete descriptions. Skin and eye irritations,

chemical burns and toxic exposures (through skin exposure, ingestion, or inhalation) are primary hazards. Injuries may be of an acute nature as well as chronic. Chemical injuries are extremely serious. Engineering controls, such as fume hoods, should be used firstly, with safe operating procedures and personal protective equipment as additional safeguards. See also CLEANING CHEMICAL SPILLS.

- chemical goggles
- face shield (for corrosive chemicals)
- chemically resistant apron
- chemically resistant footwear
- chemically resistant gloves
- respirator (if necessary)

Lead Brick Handling

The likely injury when handling lead bricks at SRC would be due to the brick falling on one's foot or a musculoskeletal injury from improper lifting. Toxic effects of lead are due to inhaling lead fumes or dust, which should not occur at SRC. Casting of lead bricks is prohibited at the SRC. The major hazard is of an acute nature, the risk level is possible, as it is when handling any heavy material, but the seriousness level is not high.

- protective footwear
- safety glasses with side shields
- gloves (type applicable to activity)
- back support belt (if necessary)

Liquid Nitrogen And Other Cryogenic Liquid Use/Dispensing

Injuries resulting from exposure to cryogenic liquids to skin or eyes may result in serious burns and tissue damage (frostbite). When dispensing or using cryogenic liquids, spattering is very frequent. Injury is highly possible, particularly if personal protective equipment is not used. Depending on the degree of burn or tissue damage, the injury could be temporary or permanent.

- chemical goggles
- face shield
- insulated gloves

Machine Shop

The incidence of injuries is very high in machine shops. Not only is there a possibility of injury from machinery, but there exists hazards due to welding, grinding, chemicals used in machine shops, and from handling materials. Injuries to the musculoskeletal system are possible if proper material handling procedures are not followed. Injuries may be acute and temporary, which are the majority, for example, a particle irritating the eye or a laceration caused by a sharp piece of metal. Injuries may also be severe, for example, a lathe operator's hand being mangled by machinery. Injuries one does not always consider include the chronic effects of using cutting oils. The chemicals in the oil may cause skin disorders. Injuries and/or illnesses may also result from welding. Damage to the eyes from the intense light, burns, and respiratory illness all may result from welding. The risk level therefore is highly probable, with the seriousness level likely to be of a temporary nature, but chronic hazards do exist in machine shops. See also MATERIAL HANDLING and WELDING AND SOLDERING.

- safety glasses with side shields

- protective footwear
- face shield (during grinding or sanding)
- welding protection (insulated gloves, apron, helmet with proper filter)
- respiratory protection (if necessary)
- hearing protection (if 8 hour TWA exceeds 85 dBA)

Maintenance and Lawn Care

Maintenance personnel face a variety of injuries and illnesses while conducting maintenance activities. Acute injuries, such as exposure to hazardous chemicals, hand, foot or eye injuries, falls, and electrical shock may result when safe working practices are not followed. Chronic exposure to lubricants or other chemicals may result in serious illness, while injuries to the musculoskeletal system are possible if proper material handling procedures are not followed. Chronic exposure to excessive noise levels may damage hearing permanently, although only temporary damage to hearing should result from acute excessive noise levels. While most acute injuries may not be serious, falls, electrical shock and exposure to hazardous chemicals may result in life threatening trauma. Chronic injuries or illness, including cumulative trauma, may have a profound effect on personnel and should be regarded as serious.

- eye protection (type applicable to activity)
- protective footwear
- gloves (type applicable to activity)
- hearing protection (if 8 hour TWA exceeds 85dBA)
- cold weather/rain gear (during inclement weather)
- back support belt (if necessary)
- body harness (for fall protection)

Material Handling and Stockroom

Material handling/stockroom personnel face cumulative trauma and musculoskeletal injuries primarily. However acute injuries they face include lacerations or punctures (during opening or handling of packages), and foot, back, hand or eye injuries. As indicated, chronic injuries would include cumulative trauma and musculoskeletal injuries. By using proper body mechanics, the majority of hazard associated with material handling may be avoided. While loading or unloading materials into or from trucks or transporting materials by forklift or handtruck, potential for a foot injury exists.

- protective footwear
- back support belt
- eye protection (type applicable to activity)
- gloves (type applicable to activity)

Painting

Injuries and illnesses faced during painting result mainly from inhalation of paint mists. Additionally chemicals found in paint may cause illness through skin or eye contact. Eye, hand, foot and back injuries may occur during the painting and handling of the material painted. Both acute and chronic injuries and illness occur through painting. Proper engineering controls and respiratory protection eliminate most hazards. Respiratory illness should be regarded as serious,

especially in the case of chronic exposure. Allergens found in paints may cause serious reactions in those chronically exposed to such paints.

- chemical goggles
- respirator (if necessary)
- chemically resistant gloves
- protective footwear
- protective suit or apron (if necessary)
- back support belt (if necessary)

Water-Treatment Chemical Handling

At SRC, corrosive chemicals are used to treat the water that cools the bending magnets. The principal hazard being an acute injury due to chemical burn. An exposure may occur if water treatment chemicals are spilled during handling. The danger level is serious due to the corrosivity of the chemicals involved. Hazards from chronic exposure may be less than those posed by an acute exposure. Accidents or incorrect movement during material handling could result in musculoskeletal injuries. These could be either acute or chronic injuries. See MATERIAL HANDLING and CLEANING CHEMICAL SPILLS.

- chemical goggles
- protective footwear
- face shield
- chemically resistant apron
- chemically resistant gloves
- respirator (if necessary)
- back support belt (if necessary)

Welding and Soldering

Soldering takes place throughout KRC, while welding takes place in the KRC machine shops. Both activities face risk of respiratory illness due to chronic exposure to welding and soldering fumes and gases. Without proper engineering controls and respiratory protection, the risk of illness is severe, with the level of illness being serious. Other hazards facing soldering include flying object hazards. This hazard exists when cutting wire or working with small electronics. This would be an acute hazard, but would not be a serious hazard if precautions are taken. Welding hazards include material handling (see MATERIAL HANDLING), electrical shock (high voltage power supply-arc welding), thermal burns, lacerations from metal, and damage to the eyes (UV, IR and intense visible light). Both acute or chronic injuries and illnesses may result in serious harm if proper work practices are not followed.

- eye protection (soldering: safety glasses with side shields; welding: helmet with proper filter)
- insulated gloves (welding)
- insulated apron (welding)
- protective footwear (welding)
- respirator (if necessary)
- back support belt (if necessary)

7. Protective Equipment

Emergency Showers

- Easily accessible emergency showers may be found in the SRC Chemical Storage Building, SRC Chemical Room, SRC Mechanical Equipment Room, CNTech Process Cleanroom, PSL Vacuum Test Area, and PSL welding shop.
- Pulling down on the handle will engage the shower. Pushing up on the handle will stop the water flow.

Emergency Eyewashes

- Emergency eyewashes may be found in the SRC Chemical Storage Building, SRC Chemical Room, SRC Equipment Room, CNTech Process Cleanroom, PSL Vacuum Test Area, PSL First Aid Room, and PSL welding shop.
- To operate, the face must be lowered to within a few inches of the spouts after turning on the water flow. To turn on the water flow, push the handle away from you. To stop the flow of water, pull the handle toward you.

Emergency Wash Bottles

- Emergency saline wash bottles are positioned throughout the KRC. They may be used as a first aid measure. After beginning first aid treatment with the saline wash bottle, promptly go to the nearest emergency shower or eyewash to continue treatment. Personnel whose eyes are injured should seek medical attention as soon as possible.

Fire Extinguishers

Fire extinguishers are classed by the type of fire the extinguisher may be used upon. There are four classes of extinguisher. All may be found at KRC. The classes:

- "A" Common rubbish, paper, wood
 - "B" Flammable liquid, grease
 - "C" Electrical
 - "D" Flammable metal
-
- Fire extinguishers are located throughout the KRC. Dry chemical, carbon dioxide, and Halon fire extinguishers are found at SRC, except in the Aladdin vault where only Halon and Class D fire extinguishers are found. Dry chemical, carbon dioxide, and Class D extinguishers are found at PSL. Dry chemical and Halon extinguishers are found at CNTech.
 - Each fire extinguisher is labeled and tagged with the type of fires it may extinguish and the type of extinguishing agent it contains.
 - Halon fire extinguishers are ABC rated (wood/paper, flammable liquid, and electrical) and do not leave a residue. Halon extinguishers are commonly used in areas where delicate electrical or sensitive materials are stored. Halon extinguishers should only be used in large well ventilated areas. Halon is a gas and may be inhaled. If inhaled in sufficient volume, asphyxiation may occur.
 - Dry chemical fire extinguishers are also ABC rated, but do leave a residue. This residue may contaminate electrical equipment, computers, and UHV equipment. Dry chemical fire extinguishers are not located in the SRC Aladdin vault.

- Carbon dioxide fire extinguishers are rated BC, and should only be used on electrical fires or flammable liquid fires. A carbon dioxide fire extinguisher is generally distinguished by its large “cow bell” nozzle and the lack of a pressure gauge.

Other Emergency Equipment

- Telephones are located throughout the KRC. The Emergency phone number (911) is posted on all phones.
- First aid supplies can be found throughout the KRC. First aid kits contain supplies for minor injuries or may serve as a first response for larger injuries.
- A large First Aid Locker, located in the SRC, and a First Aid Room in the PSL contain extensive supplies of first aid equipment including cold packs, bandages, antiseptics, gauze, crutches, medical gloves, and a stretcher.
- The SRC Aladdin vault Emergency Stop Button may be depressed to prevent an injection from occurring. The Emergency Stop Buttons are located on each vault wall beneath the wall lights.
- High voltage disconnect poles are placed in areas where potential for electrical shock exists. The pole’s primary purpose is to be used as an insulated pole for operating a high voltage switch. The pole may also be used for pulling persons away from a piece of equipment or energized cable if the person cannot release his/her grip during electrical shock.

Chapter 10. Respiratory Protection

1. Policy

The purpose of the Respiratory Protection Program is to ensure the protection of all personnel from respiratory hazards through engineering and work practice controls, air monitoring and proper use of respirators. Respirators are to be used where engineering controls or work practice controls of respiratory hazards are not feasible. The SRC Engineering Group, SRC Operations Group, PSL Facilities Maintenance Group, CNTech Maintenance Group, and PSL and SRC machine shop personnel are the principal focus of respiratory protection. This program meets requirements of Wisconsin COM 32 “Public Employee Safety and Health”.

At the KRC, the preferred method of respiratory protection is by using engineering controls (i.e. fumehoods, local exhaust, flowhoods, or benchtop soldering exhaust) or work practice controls (i.e. wetting powder or substitution) to eliminate or minimize airborne contamination. When engineering controls or work practices do not reduce personnel or user exposure below OSHA Permissible Exposure Levels (PEL's), respiratory protection shall be worn to reduce personal exposure below PEL's. At air contaminant concentrations below OSHA PEL's it is at the discretion of the worker to wear a respirator.

Air monitoring will be conducted where OSHA PEL's may reasonably be expected to be exceeded. Air monitoring may be done by the KRC Safety Specialist with the assistance of the UW Safety Department.

Mandatory Respiratory Protection Program (MRPP)

When personnel are performing a task where an air contaminant concentration exceeds its OSHA PEL, personnel shall participate in the MRPP. Affected personnel will be certified to use respirators, have been cleared by medical personnel, participate in annual respiratory protection training, and passed a qualitative fit test. Respirators will be assigned to individuals and shall not be shared. The assigned respirator must be worn when working in areas or at tasks when the OSHA PEL is exceeded for air contaminants. A specific respirator, cartridge and/or filter will be assigned for specific air contaminant exposures.

Voluntary Respiratory Protection Program (VRPP)

Under COM 32 rules for a VRPP, employers shall not require an employee to wear a respirator unless an air contaminant's concentration exceeds the OSHA PEL. However, employees may choose to wear a respirator for additional comfort, protection, or avoid exposure to hazards even when air contaminant exposure limits are not exceeded. An employer may make available to personnel respirators which may be used voluntarily. Only NIOSH approved respirators will be available to personnel. It is at the employee's discretion to wear a respirator. It is also the employee's responsibility to follow the manufacturer's instructions in the selection, use, cleaning, inspection, maintenance, storage, and limitations of the respirator. Employees who voluntarily choose to wear a cartridge respirator must be cleared by medical personnel prior to use of a cartridge respirator.

2. Definitions

Aerosol- A gaseous suspension of fine solid or liquid particles.

Air purifying respirator- A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing inhaled air through the air-purifying element.

Cartridge respirator- A type of air purifying respirator which uses a container with a filter, sorbent, or catalyst, or combination of these items, to remove specific contaminants from the air passed through the container.

Comfort mask- Name given to a mask worn by individuals who wish to filter their exhalation and prevent deposition of aerosol or particulates on a cleaned or UHV part. Commonly called a dust mask. A comfort mask will have only one strap, while a filtering facepiece respirator will have two straps. Do not wear a comfort mask for respiratory protection.

Dust- Tiny suspended particles resulting from a mechanical process such as grinding.

Filter efficiency- Ability of filtering facepiece respirator to filter out particles of 0.3 micron size or larger. Efficiencies of 95% or 100% are used most often.

Filtering facepiece respirator- A type of air purifying respirator which uses a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium. Not to be confused with a comfort mask. A comfort mask will have only one strap, while a filtering facepiece respirator will have two straps. There are three classifications of filtering facepiece respirators: N, R, and P. There are also three efficiencies: 95%, 99%, and 100%.

Fit Test- A qualitative or quantitative evaluation of the fit of a respirator on an individual.

Fume- Very small particles formed by a condensing gas or vapor as in welding.

High Efficiency Particulate Air (HEPA) filter- A filter that is at least 99.97% efficient in removing particles of 0.3 microns in diameter.

Immediately Dangerous to Life or Health (IDLH)- Condition when the atmosphere poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Mist- An aerosol composed of liquid particles.

N class- Classification of filtering facepiece respirator for non-oil aerosol environments.

NIOSH- National Institute for Occupational Safety and Health

P class- Classification of filtering facepiece respirator for non-oil and oil aerosol environments and can be worn for longer than 8 hours.

OSHA PEL- An exposure limit established by OSHA. It generally refers to the level of exposure a human may be exposed to a chemical for a 40 hour work week without adverse health effect.

Qualitative Fit Test- A pass/fail test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

R class- Classification of filtering facepiece respirator for non-oil and oil aerosol environments, limited to no more than a 8 hour exposure.

User seal check- Test conducted by the respirator user to determine if the respirator is properly sealed to the face.

Vapor- Gaseous form of a liquid or solid material.

3. Responsibilities

Personnel working in areas or performing tasks when air contaminant concentrations exceed OSHA PEL's are responsible for

- Using all feasible engineering controls or proper work practices to safely minimize personal exposures to hazardous airborne contamination.
- Selecting the appropriate respiratory protection when required.
- Properly wearing, inspecting, maintaining, cleaning, and storing respiratory protection in accordance with the instructions and training received.
- Identifying routine, non-routine, and emergency respiratory hazards in the workplace and notifying the facility safety officer or KRC Safety Specialist so that the need for proper respiratory protection can be assessed.
- Successfully completing the required Respiratory Protection Training.
- Completing an annual respirator qualitative fit test.
- Completing an annual medical exam to ensure they are physically able to wear a respirator.
- Notifying the facility safety officer or KRC Safety Specialist of potential health changes that may affect their ability to wear a respirator.

All personnel are responsible for

- Identifying routine, non-routine, and emergency respiratory hazards in the workplace and notifying the facility safety officer or KRC Safety Specialist so that the need for proper respiratory protection can be assessed.

Personnel who opt to follow the Voluntary Respiratory Protection Program are responsible for

- Following the Mandatory Respiratory Protection Program when air contaminant concentrations exceed OSHA PEL's.
- Following the instructions provided by the manufacturer of the respirator on inspection, use, maintenance, cleaning and care, and warnings regarding the respirator's limitations.
- Choosing respirators certified for use to protect against the contaminant and concentration of concern. A label of certification should appear on the respirator or

respirator packaging. It may tell you what the respirator is designed for and how much it will protect you.

- Do not wear your respirator into atmospheres containing contaminants or concentrations for which your respirator is not designed to protect against. A respirator designed to filter dust particles will not protect against gases, vapors or very small particles of fumes or smoke.
- Do not use someone else's respirator.
- Completing a medical questionnaire, if choosing to use a cartridge respirator.
- Reading Appendix D to OSHA 1910.134, which is provided to each person obtaining a voluntary use respirator.

The facility safety officers and KRC Safety Specialist are responsible for

- The proper implementation of respiratory protection to ensure all personnel are safely protected from hazardous airborne contaminants.
- Developing and maintaining a written Respiratory Protection Program in compliance with the COM 32 “Respiratory Protection Standard” (29 CFR 1910.134).
- Evaluating potential hazards, recommending engineering controls, selecting, fit testing, and issuing respiratory protection appropriate for the contaminant and concentration of concern.
- Developing and conducting training courses for the use of respirators.
- Monitoring the Voluntary Respiratory Protection Program.
- Conducting air monitoring in areas where it may reasonably be expected that air contaminants could exceed OSHA PEL's.

4. Mandatory Respiratory Protection Program Requirements

Hazard Evaluation

Inhalation is a major route of entry for chemical substances. For this reason, hazard identification and evaluation is the important first step in respiratory protection. At a minimum, you should be aware of the properties of the hazardous materials and how you can minimize your personal exposure when handling the material. There are many ways to identify respiratory hazards at the KRC including the following: scheduled workplace inspections, conducting air monitoring to determine exposure concentrations of airborne contaminants, or workers seeking safety and health assistance when a hazard is suspected.

Engineering and Work Practice Controls

Respiratory protection is considered the last line of defense for protecting health and should be used when control techniques are not feasible or completely successful in reducing personal exposures to safe levels. After a respiratory hazard has been identified, a safe operating procedure must be completed to safely control worker exposure. The following are examples of control techniques that may be used to reduce airborne contaminants:

- Substitution: replacing hazardous materials with a lower hazard potential (i.e., substituting a halogenated solvent with a nonhalogenated solvent).
- Wet methods: keeping hazardous material that may become airborne damp to reduce airborne contamination.

- Isolation: physically isolating a material, process, or operation to eliminate or reduce hazardous exposures to personnel.
- Enclosure: enclosing an entire process or operation to prevent the escape of contaminants into the lab.
- Local exhaust ventilation: capturing hazardous materials at the point of generation by means of exhaust ventilation.

Examples of engineering controls established by KRC include the fume hood in the SRC Chemical Room, the ventilated spray paint booth at PSL, and the local ventilation for the SRC Machine Shop welding activities.

Respirator Selection

Once a respiratory hazard is identified, the KRC Safety Specialist will assist personnel in selecting the proper respiratory protection based on the nature of the hazard. Selection will be made in compliance with COM 32/OSHA "Respiratory Protection Standard". Only NIOSH approved respirators will be individually assigned to personnel.

Two types of air purifying respirators may be found at KRC. Cartridge type respirators may provide adequate protection from dusts, vapors, and with appropriate filters mists and fumes. This type has two removable cartridges on the facepiece, which can be replaced with the appropriate filters for the air contaminant needed protection from. Filtering facepiece respirators may provide adequate protection from dusts, mists and fumes. Do not use a filtering facepiece respirator when vapors or gases are generated. Filtering facepiece type respirators resemble simple "dust masks" but may have an exhalation valve on the facepiece and have two straps. The facepiece acts as the filtering medium, unlike the cartridge type respirator.

Air purifying respirators are not to be used in conditions which are Immediately Dangerous to Life or Health (IDLH).

Ensure that the respirator you use is appropriate to the air contaminant and concentration of concern. A label on the respirator, cartridge, or filter may indicate the air contaminant it is effective against. If you are unsure if your respirator is appropriate for the air contaminant or concentration, contact the KRC Safety Specialist for assistance.

For filtering facepiece respirators, the proper classification and efficiency must be chosen. "N" classification must only be used in a non-oil aerosol environment. For example, while cutting wood or cleaning up asbestos. "R" or "P" classifications must be used in an oil aerosol environment, and may also be used in a non-oil aerosol environment. For example, working in a machine shop. An oil aerosol includes cutting fluids, lubricants and glycerine. The "R" and "P" classification are also length of exposure dependent. "P" may be worn for longer than 8 hours, while "R" may be used for no longer than 8 hours. The efficiency necessary for work at SRC generally does not need to be greater than 95%. However, if you are working with lead asbestos, cadmium you must use a filtering facepiece respirator with an efficiency of 100%.

For spray painting, an appropriate filtering facepiece respirator or cartridge respirator with organic vapor cartridge and at least "P95" classification spray paint prefilter may be worn. A cartridge respirator must be worn if air contaminant levels exceed the PEL for a contaminant.

For welding, either a cartridge respirator with appropriate cartridge and filter, or a filtering facepiece respirator suitable for welding, with an "R" or "P" classification may be used.

Cartridge respirators for mandatory use will be issued to qualified individuals. Replacement cartridges, prefilters, and cartridge respirator facepieces may be obtained from the KRC Safety Specialist. Filtering facepiece respirators may be obtained from the KRC Stockroom. Replaceable cartridges and cartridge respirator facepieces shall only be obtained by persons who have completed KRC's Respiratory Safety training and passed a respiratory physical. Descriptions of respiratory safety equipment provided by the KRC Stockroom and the contaminants the respiratory equipment are designed to filter will be posted.

Medical Examination

For mandatory users of respirators, prior to issuance of a respirator or fit test, a medical examination must be conducted to determine if the worker is physically able to work while wearing a respirator. This physical examination may consist of a medical questionnaire or may involve medical tests. Only workers found to be physically able by a physician will be allowed to perform a task which requires that a respirator be worn. Clearances will be filed with the KRC Safety Specialist. The medical examination will be arranged through the KRC Safety Specialist. Cost of the medical examination is absorbed by the employee's department. Medical records are maintained only at the medical facility conducting the respiratory physical.

Respiratory Protection Training

Each respirator wearer, for routine and non-routine tasks, must be trained in the proper use and limitations of the respirator issued. A video tape presentation and discussion of respiratory protection will be followed by a qualitative fit-test of issued respirators. Upon successful completion of the fit-test, the cartridge respirators will be individually assigned to personnel. Personnel will also be instructed on the proper inspection, cleaning, maintenance, and storage of their respirator. Attendance at the Respiratory Protection Training will be documented.

Qualitative Fit Test

A qualitative fit test for cartridge respirators must be administered by the KRC Safety Specialist during the annual Respiratory Protection Training. In this test a worker, after performing a positive and negative pressure fit test, will be exposed to an odorous vapor. The test will be conducted while the worker is duplicating motions made during normal activities. If the worker does not detect the odor, he/she has passed the qualitative fit test. If the odor is detected, reposition and retest until the odor is not detected. Results of the qualitative fit test will be documented.

Inspection, Cleaning, Maintenance, and Storage

Each respirator issued will be inspected and stored in a sealed plastic bag. It is the responsibility of the user to inspect before use, clean after use, properly maintain, and store their respirator. Contact the KRC Safety Specialist if you have any questions.

Inspect your cartridge respirator before and after each use. Check all parts for damage, particularly rubber or plastic parts. Check all valves and seals for dirt or grit. Examine prefilters and cartridges. Immediately replace damaged parts or discard the respirator. Use only parts specific to the particular respirator.

Inspect the filtering facepiece respirator each time it is placed on your face. Examine the filter for tears, visible contamination, or other signs of damage. Ensure the mask will provide a tight face to facepiece seal. Immediately discard the mask if any damage is visible or it does not provide a tight seal.

Each cartridge respirator user will perform a positive and negative pressure fit-test each time it is placed on the user's face, to ensure the respirator is working properly. To perform a positive pressure check, place the palm of your hand over the exhalation valve cover and exhale. If the facepiece bulges slightly, and no leaks between your face and the facepiece occur, a proper fit has been achieved. To perform a negative pressure check, place a palm of your hand over each inhalation filter. Inhale and hold your breath. If the facepiece collapses slightly, a proper fit has been achieved. If any leakage occurs reposition the facepiece and repeat the positive and negative pressure checks until a proper fit is achieved.

Cartridge type respirators must be cleaned after each use. To clean, take off the cartridges, prefilters, headbands, and prefilter holders. Wash the facepiece in soapy water. Rinse in warm water and let the facepiece air dry on a shelf or counter. Do not use harsh cleaners or solvents to disinfect the facepiece. The chemicals may cause damage to the facepiece material. Follow manufacturer instructions for the cleaning of filtering facepiece respirators.

Store your respirator in a location that protects it from dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Placing a cartridge respirator in a sealable bag will prolong the life of the cartridge. The cartridge must still be replaced after thirty days. Do not hang the facepiece by the headbands or place it in a position that may cause distortion of the facepiece which could create a poor face to respirator seal.

Respirator Use

Ensure that manufacturer's instructions in the use of the respirator are followed. Failure to follow manufacturer instructions may expose the wearer to airborne contaminants which could cause illness. Choose a respirator certified for use to protect against the air contaminant of concern. The respirator facepiece or cartridge should be labeled with the type contaminant it will protect against. Do not wear a respirator into atmospheres containing contaminants or concentrations for which the respirator is not designed.

If using a cartridge respirator, do not mix brands of cartridges with facepieces. Cartridges must be replaced regularly. Once removed from its sealed bag, a cartridge has a maximum of thirty days lifespan whether it is used or not. Cartridges must be replaced at least every thirty days. They shall be replaced prior to the thirty day maximum lifetime if any of the below listed conditions are met, or prefilters, masks, or cartridges have visible contamination. As an example, 2.5 hours of exposure to acetone and methyl ethyl ketone, two common components of

spray paints, at their OSHA PEL's will use up the life of the cartridge. Humidity may also shorten the lifespan of a cartridge. In all cases, follow the manufacturer's instructions on lifespan of the respiratory protection. Mark on the cartridge or respirator the date it is taken out of its sealed package.

If using a filtering facepiece respirator or spray paint prefilter, when it becomes damaged, soiled, or breathing becomes difficult, leave the contaminated area and dispose of the respirator. If used in environments containing oil aerosols, dispose of the respirator after 40 hours of use or 30 days after taking out of package, whichever comes first. Mark on the respirator the date it is taken out of its sealed package.

Always perform a positive and negative pressure fit-test of a respirator before using. See the above section for fit-test instructions.

Immediately leave the area and replace the respirator or cartridges if
Breathing becomes difficult
Dizziness occurs
You detect irritation, smell or taste contaminants
The respirator becomes damaged

No respirator should be used by persons with beards or other facial hair. Facial hair may cause a poor face/facepiece seal. This could expose the wearer to air contaminants.

Wear appropriate personal protective equipment when working. For example, when spray painting, in addition to a respirator, at a minimum, gloves and eye protection[goggles] should be worn.

Keep track of your respirator, so that you do not mistakenly use someone else's respirator.

5. Voluntary Respiratory Protection Program

Hazard Evaluation

Under the rules of the VRPP, personnel working in an area which has an air contaminant concentration exceeding the OSHA PEL must follow the Mandatory Respiratory Protection Program. If OSHA PEL's are not exceeded, voluntary usage of respirators is allowed.

Engineering and Work Practice Controls

If engineering or work practice controls do not reduce air contaminant concentrations below OSHA PEL's, the Mandatory Respiratory Protection Program goes into effect. If controls do reduce air contaminant levels to below OSHA PEL's, it is at the discretion of the employee to wear respiratory protection.

Examples of engineering controls established by KRC include the fume hood in the SRC Chemical Room, the ventilated spray paint booth at PSL, and the local ventilation for the SRC Machine Shop welding activities.

Respirator Selection

Under the COM 32 rules for VRPP, respirators are not assigned to individuals by the employer. Employers may make respirators available to personnel. Only NIOSH approved respirators will be available to personnel. It is at the employee's discretion [when PEL's are not exceeded] to wear a respirator. It is also the employee's responsibility to follow the manufacturer's instructions in the selection, use, cleaning, inspection, maintenance, and limitations of the respirator. Ensure that the respirator you choose is appropriate to the air contaminant and concentration of concern. A label on the respirator, cartridge, or filter may indicate the air contaminant it is effective against. If you are unsure if your respirator selection is appropriate for the air contaminant or concentration, contact the KRC Safety Specialist for assistance.

The Voluntary Respiratory Protection Program is allowed only when OSHA PEL's for airborne contaminants are not exceeded. Two types of air purifying respirators may be found at KRC. Cartridge type respirators may provide adequate protection from dusts, vapors, and with appropriate filters mists and fumes. Filtering facepiece respirators may provide adequate protection from dusts, mists and fumes. Do not use a filtering facepiece respirator when vapors or gases are generated. Filtering facepiece type respirators resemble simple "dust masks" but may have an exhalation valve on the facepiece and have two straps. The facepiece acts as the filtering medium, unlike the cartridge type respirator. Filtering facepiece respirators may be obtained by those voluntarily using respirators. The use of cartridge type respirators require Respiratory Safety training and a respiratory physical.

For filtering facepiece respirators, the proper classification and efficiency must be chosen. "N" classification must only be used in a non-oil aerosol environment. For example, while cutting or sanding wood. "R" or "P" classifications must be used in an oil aerosol environment, and may also be used in a non-oil aerosol environment. For example, working in a machine shop. An oil aerosol includes cutting fluids, lubricants and glycerine. The "R" and "P" classification are also length of exposure dependent. "P" may be worn for longer than 8 hours, while "R" may be used for no longer than 8 hours. The efficiency necessary for work at SRC generally does not need to be greater than 95%. However, if you are working with asbestos, cadmium, or lead, you must use a filtering facepiece respirator with an efficiency of 100%.

For spray painting, an appropriate filtering facepiece respirator or cartridge respirator with organic vapor cartridge and at least "P95" classification spray paint prefilter may be worn. A cartridge respirator must be worn if air contaminant levels exceed the PEL for a contaminant.

For welding, either a cartridge respirator with appropriate cartridge, or a filtering facepiece respirator suitable for welding, with a "R" or "P" classification may be used.

Filtering facepiece respirators may be obtained from the KRC Stockroom. Appendix D of OSHA 1910.134 must be given to each person obtaining a respirator. Replaceable cartridge respirators may only be obtained by persons who have completed KRC's Respiratory Safety training and have completed a respiratory questionnaire and if necessary passed a respiratory examination. Descriptions of respiratory safety equipment provided by the KRC Stockroom and the contaminants the respiratory equipment are designed to filter will be posted.

Medical Questionnaire

A medical questionnaire is not required by COM 32 for use of filtering facepiece respirators. If a worker chooses to wear a cartridge respirator, a respiratory questionnaire shall be completed and reviewed by a health professional before a worker may use a cartridge respirator. A respiratory examination will be conducted if the medical questionnaire demonstrates the need for a physical exam. Clearances will be filed with the KRC Safety Specialist. The medical questionnaire and respiratory examination will be arranged through the KRC Safety Specialist. Cost of the medical examination is absorbed by the employee's department. Medical records are maintained only at the medical facility conducting the medical questionnaire or respiratory examination.

Respiratory Protection Training

Training is made available to voluntary respirator wearers in the proper use and limitations of the respirators available. A video tape presentation and discussion of respiratory protection will be followed by a demonstration on fit-testing cartridge respirators. Personnel will also be instructed on the proper inspection, cleaning, maintenance, and storage of respirators. Copies of Appendix D of OSHA 1910.134 are given each time a voluntary wearer of respiratory protection obtains respiratory protection from the KRC Stockroom.

Qualitative Fit Test

A qualitative fit test is not required by the VRPP.

Inspection, Cleaning, Maintenance, and Storage

It is the responsibility of the user to inspect before use, clean after use, properly maintain, and store their respirator. Contact the KRC Safety Specialist if you have any questions.

Inspect your cartridge respirator before and after each use. Check all parts for damage, particularly rubber or plastic parts. Check all valves and seals for dirt or grit. Examine prefilters and cartridges. Immediately replace damaged parts or discard the respirator. Use only parts specific to the particular respirator.

Inspect the filtering facepiece respirator each time it is placed on your face. Examine the filter for tears, visible contamination, or other signs of damage. Ensure the mask will provide a tight face to facepiece seal. Immediately discard the mask if any damage is visible or it does not provide a tight seal.

Each cartridge respirator user should perform a positive and negative pressure fit-test each time it is placed on the user's face, to ensure the respirator is working properly. To perform a positive pressure check, place the palm of your hand over the exhalation valve cover and exhale. If the facepiece bulges slightly, and no leaks between your face and the facepiece occur, a proper fit has been achieved. To perform a negative pressure check, place a palm of your hand over each inhalation filter. Inhale and hold your breath. If the facepiece collapses slightly, a proper fit has been achieved. If any leakage occurs reposition the facepiece and repeat the positive and negative pressure checks until a proper fit is achieved.

Cartridge type respirators should be cleaned after each use. To clean, take off the cartridges, prefilters, headbands, and prefilter holders. Wash the facepiece in soapy water. Rinse in warm water and let the facepiece air dry on a shelf or counter. Do not use harsh cleaners or solvents to disinfect the facepiece. The chemicals may cause damage to the facepiece material. Follow manufacturer instructions for the cleaning of filtering facepiece respirators.

Store your respirator in a location that protects it from dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Store a cartridge respirator in a sealable bag. Placing a cartridge respirator in a sealable bag will prolong the life of the cartridge. Do not hang the facepiece by the headbands or place it in a position that may cause distortion of the facepiece which could create a poor face to respirator seal.

Respirator Use

Ensure that manufacturer's instructions in the use of the respirator are followed. Failure to follow manufacturer instructions may expose the wearer to airborne contaminants which could cause illness. Choose a respirator certified for use to protect against the air contaminant and concentration of concern. The respirator facepiece or cartridge should be labeled with the type of contaminant it will protect against. Do not wear a respirator into atmospheres containing contaminants or concentrations for which the respirator is not designed.

Once removed from its sealed bag, a cartridge has a maximum of thirty days lifespan whether it is used or not. They shall be disposed prior to the thirty day maximum lifetime if any of the below listed conditions are met, or prefilters, masks, or cartridges have visible contamination. As an example, 2.5 hours of exposure to acetone and methyl ethyl ketone, two common components of spray paints, at their OSHA PEL's will use up the life of the cartridge. Humidity may also shorten the lifespan of a cartridge. In all cases, follow the manufacturer's instructions on lifespan of the respiratory protection. Mark on the cartridge or respirator the date it is taken out of its sealed package.

If using a filtering facepiece respirator or spray paint prefilter, when it becomes damaged, soiled, or breathing becomes difficult, leave the contaminated area and dispose of the respirator. If used in environments containing oil aerosols, dispose of the respirator after 40 hours of use or 30 days after taking out of package, whichever comes first. Mark on the respirator the date it is taken out of its sealed package.

Always perform a positive and negative pressure fit-test of a respirator before using. See the above section for fit-test instructions.

Immediately leave the area and replace the respirator if

- Breathing becomes difficult
- Dizziness occurs
- You detect irritation, smell or taste contaminants
- The respirator becomes damaged

No respirator should be used by persons with beards or other facial hair. Facial hair may cause a poor face to facepiece seal. This could expose the wearer to air contaminants.

Wear appropriate personal protective equipment when working. For example, when spray painting, in addition to a respirator, at a minimum, gloves and eye protection[goggles] should be worn.

Keep track of the respirator you are using, so that you do not mistakenly use someone else's respirator.

6. Confined Space Procedures

Do not enter a confined space or attempt to rescue personnel while wearing an air purifying respirator when a hazardous atmosphere is present. See Chapter 36 "*Confined Space Operations*". Continuously monitor for air contaminants. Evacuate when air contaminant concentrations are hazardous, or when the oxygen concentration is less than 19.5%.

7. Emergency Procedures

None of the respiratory protection available at KRC will offer protection in case of emergency. Do not use an air-purifying cartridge or filtering facepiece respirator in environments Immediately Dangerous to Life or Health (IDLH).

Immediately evacuate any area where hazardous levels of airborne contaminants exists. If you detect an odor(s) while wearing a respirator, immediately evacuate the area. Assume a high concentration of airborne contaminants exists, unless it can be immediately determined that the respirator, cartridge or filter needs to be replaced or that a poor facepiece to face seal resulted in the detection of odor(s).

Chapter 11. Records

1. Policy

It is KRC's policy to comply with Wisconsin State Statute 101.055 in the logging of recordable injuries and illnesses, and to guarantee right of access to personnel exposure and medical records per Wisconsin COM 32 "Public Employee Safety and Health".

2. Safety Reports

Safety recommendations are generally given orally, but if after three notices by the KRC Safety Specialist, the recommendations have not been followed or a valid justification given, a safety violation will be issued. The Safety Report is the last warning and will initiate further action such as disciplinary procedures or loss of beamtime.

Concerned personnel may submit a Safety Report for conditions they feel are hazardous. Safety Report forms are available from each facility's safety officer.

Safety Reports will be written by the KRC Safety Specialist following all accidents or safety incidents. Completed Safety Reports will be kept on file permanently.

3. Chemical Hygiene Plan

Chemical Hygiene Plan records will document that the facilities and precautions are compatible with current knowledge and regulations.

4. Chemical Inventory

SRC User hazardous chemical inventory and usage records will be kept in a computer database and in hardcopy files. This information will be made available to any personnel requesting information. Contact the KRC Safety Specialist for these records.

Inventory sheets of chemicals stored in the SRC Chemical Storage Building are posted in the appropriate areas of that building. An inventory of chemicals stored in the CNTech Process Cleanroom is posted at the door. Inventories are updated regularly.

An inventory of surplus and waste chemicals routed to the UW Safety Department is maintained by the KRC Safety Specialist.

5. Material Safety Data Sheets

KRC is required to have MSDS's on file for all chemicals used at KRC. KRC maintains files of the MSDS's and ensures that they are accessible to all personnel. Please contact the KRC Safety Specialist to determine if you need to submit a MSDS. Personnel are asked to provide the KRC Safety Specialist copies of MSDS's for all chemicals they will be using.

The MSDS's are available to personnel and Users at all times. They are maintained in the file cabinet adjacent to the SRC Operations Check-in Desk, in the PSL First Aid Room, and in the office of the KRC Safety Specialist.

MSDS's may also be obtained through an internet search using the links provided in the index of the KRC online safety manual.

6. Medical Records

Any medical records given to a facility's safety officer will be retained by the facility in accordance with the requirements of state and federal regulations.

7. Safety Violations

Records of safety violations will be maintained by the appropriate facility safety officer and/or KRC Safety Specialist.

Safety recommendations are generally given orally, but if after three notices by the KRC Safety Specialist, the recommendations have not been followed or a valid justification given, a safety violation will be issued. The Safety Report is the last warning and will initiate further action such as disciplinary procedures or loss of beamtime. Extremely hazardous operations will be shut down immediately.

8. Safety Committee Notes

All notes, memorandums, and decisions by the safety committees are filed and maintained by facility safety officers and the KRC Safety Specialist.

9. Injury and Illness Logs

- Non-recordable injury or illness: bruise, small cut, sliver, etc. that can be treated on-site with no medical treatment from a doctor or other medical personnel.
- Recordable injury or illness: one that requires outside medical treatment (stitches, cast, etc.) or continuing therapy (injured back, etc.). Classified as an injury or illness requiring anything beyond first aid treatment.
- Recordable injuries or illnesses are required by law to be documented by the employer. Non-recordable injuries or illnesses are not. However, it is a useful tool for safety staff to keep track of minor injuries. If a trend of similar injuries is occurring, changes should be made to prevent future occurrences. Please let the KRC Safety Specialist know of all injuries or illnesses.

For KRC Staff:

Employees must report all injuries and/or accidents to their supervisor immediately. The injured employee must complete an Employee Workplace Injury or Illness Report and submit it to the employee's supervisor or the Personnel Director within 24 hours of the incident. The employee's supervisor must complete the Supervisor Section of the Supervisor and Safety Coordinator Investigation Report for Injury or Illness form. Once completed with their portion, the supervisor must forward this form to the Safety Manager for completion. This form must also be returned to the Personnel Director within 24 hours. These forms can be obtained in the Personnel Office or the KRC Safety Specialist and should be completed with the assistance of Personnel staff.

Occupational Safety and Health Administration (OSHA) Form 300A is to be completed and filed by each buildings safety officer annually. Form 300A documents the previous year's recordable injuries and illnesses in the workplace. Each year's log is maintained for a minimum of five years. OSHA Form 300A is posted from February 1 to April 30 of the year following the year covered by the form.

For KRC Users:

Recordable injuries and/or illnesses are to be reported to the KRC Safety Specialist by completing a "Safety Report". It is to be completed and submitted to the KRC Safety Specialist within 24 hours of the injury and/or illness. "Safety Reports" may be obtained from the facility safety officer or the KRC Safety Specialist.

10. Access To Employee Exposure And Medical Records

Wisconsin State Statute 101.0557 gives employees the right to inspect their medical and exposure records.

Chapter 12. Signs and Labels

1. Emergency Procedures and Emergency Phone Number

The emergency phone number (911) is posted on all telephones.

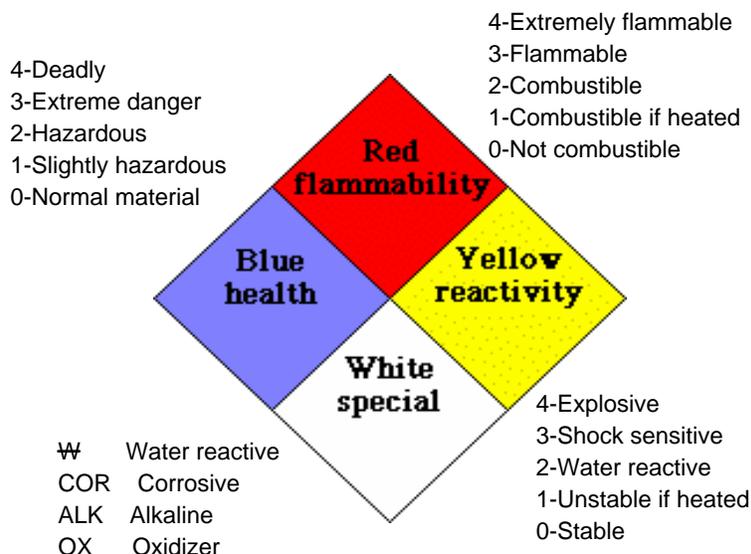
Emergency procedures are posted throughout the KRC. Emergency phone numbers and home phone numbers of KRC staff are posted near KRC telephones. Office phone extension numbers of KRC personnel are posted near all telephones.

2. HAZARD COMMUNICATION LABELS

Two types of labels are used to convey chemical hazards at the Kegonsa Research Campus. These two label types include the National Fire Protection Association (NFPA) hazard diamond and the Hazardous Materials Identification System (HMIS) rectangular bars. The labels are similar in color and hazard warnings; however, there are significant differences between the two. The NFPA and HMIS are explained next.

3. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) LABELS

NFPA labels are used to identify the contents, ownership, and the dates chemicals were put into use. All liquid and solid chemicals must have either a NFPA or an HMIS label attached to their containers. Gases do not have NFPA or HMIS symbols. Labels can be found throughout the KRC or through the KRC Safety Specialist.



The diamond symbol is divided into four regions:

- Blue indicates the health hazard.
- Red indicates the flammability.
- Yellow indicates the reactivity.
- White indicates any special hazards.
- The scale within the blue, red, and yellow regions is from 0 to 4, with 4 being the most hazardous.

HEALTH HAZARD (Blue)

Degree of hazard; level of short-term protection.

- 0 Ordinary Combustible Hazard in a Fire
- 1 Slightly Hazardous
- 2 Hazardous
- 3 Extreme Danger
- 4 Deadly

FLAMMABILITY HAZARD (Red)

Susceptibility to burning.

- 0 Will Not Burn - Any material that will not burn in air when exposed to a temperature of 815.5 °C (1500 °F) for a period of 5 minutes.
- 1 Will Ignite if Preheated - Materials that will burn in air when exposed to a temperature of 815.5 °C (1500 °F) for a period of 5 minutes or less; liquids, solids, and semi-solids having a flash point above 93.4 °C [200 °F (i.e., Class IIIB combustible liquids)].
- 2 Will Ignite if Moderately Heated - Liquids having a flash point above 37.8 °C (100 °F), but not exceeding 93.4 °C [200 °F (i.e., Class II and Class IIIA combustible liquids)]; solid materials in a dust, fibrous, or shredded form that may burn rapidly or readily give off flammable vapors, but do not form explosive atmospheres with air.
- 3 Will Ignite at Ambient Conditions - Liquids having a flash point below 22.8 °C (73°F) and having a boiling point at or above 37.8 °C (100 °F) and those liquids having a flash point at or above 22.8 °C (73 °F) and below 37.8 °C [100 °F (i.e., Class IB and Class IC flammable liquids)]; materials that can form explosive mixtures with air and materials that burn with extreme rapidity.
- 4 Burns Readily at Ambient Conditions - Flammable gases; flammable cryogenic materials; any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8 °C (73 °F) and a boiling point below 37.8 °C [100 °F (i.e., Class IA flammable liquid)]; materials that ignite spontaneously when exposed to air.

REACTIVITY, INSTABILITY (Yellow)

Energy released if burned, decomposed, or mixed.

- 0 Stable Even Under Fire Conditions and Not Reactive with Water
- 1 Unstable if Heated
- 2 Violent Chemical Change

- 3 Shock and Heat May Detonate
- 4 May Detonate at Normal Temperatures and Pressures

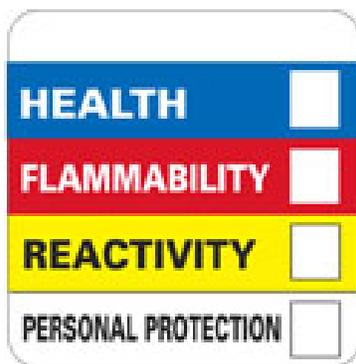
SPECIAL HAZARD (White)

Particular hazard which does not fit under the health, flammability, or reactivity classification, or a particular hazard of a chemical that bears special consideration. Only the greatest special hazard will have its symbol in this region if there are multiple special hazards. Commonly seen NFPA Special Hazard symbols include:

W	Material that is water reactive. A strenuous reaction, explosion, or toxic fumes may be generated upon exposure of this material to water.
OX	Material that is an oxidizer. Material may act as an accelerant in a fire.
COR	Material that is corrosive. Material that, on short exposure, could cause serious temporary or residual injury.
ACID	Material that is acidic (pH < 7.0).
ALK	Material that is an alkali (pH > 7.0). Also known as a base or caustic.
	Radioactive
	Poison
	Explosive
--	No special Hazard

4. HAZARDOUS MATERIALS INFORMATION SYSTEM (HMIS) LABELS

HMIS labels are used to identify the contents, ownership, and the dates chemicals were put into use. All liquid and solid chemicals must have either a NFPA or an HMIS label attached to their containers. Gases do not have NFPA or HMIS symbols. Labels can be found throughout the KRC or through the KRC Safety Department.



The label is divided into four rectangles, plus an open space at top of the label. The chemical name must be entered into the space at the top of the label. The other four regions are:

- Blue indicates the health hazard.
- Red indicates the flammability.
- Yellow indicates the reactivity.
- White indicates any required personal protection.
- The scale within the blue, red, and yellow regions is from 0 to 4, with 4 being the most hazardous.

HEALTH HAZARD (Blue)

Likelihood of a material to cause temporary or permanent injury or incapacitation due to an acute exposure by contact, inhalation, or ingestion.

- 0 Minimal - No significant risk to health.
- 1 Slight - Irritation or minor reversible injury possible.
- 2 Moderate - Temporary or minor injury may occur.
- 3 Serious - Major injury likely unless prompt action is taken and medical treatment is given.
- 4 Severe - Life-threatening, major or permanent damage may result from single or repeated exposures.

FLAMMABILITY HAZARD (Red)

- 0 Minimal - Materials that are normally stable and will not burn unless heated.
- 1 Slight - Materials that must be preheated before ignition will occur. Flammable liquids in this category have flash points (the lowest temperature at which ignition can occur) at or above 93.4 °C [200 °F (NFPA Class IIIB)].

- 2 Moderate - Materials that must be moderately heated before ignition will occur, including flammable liquids with flash points at or above 37.8 °C (100 °F) and below 93.4 °C [200 °F (NFPA Class II and Class IIIA)].
- 3 Serious - Materials capable of ignition under almost all normal temperature conditions, including flammable liquids with flash points below 22.8 °C (73 °F) and boiling points above 37.8 °C (100 °F) and liquids with flash points between 22.8 °C (73 °F) and 37.8 °C [100 °F (NFPA Class IB and IC)].
- 4 Severe - Very flammable gases or very volatile flammable liquids that have their flash points below 22.8 °C (73 °F) and boiling points below 37.8 °C [100 °F (NFPA Class 1A)].

REACTIVITY HAZARD (Yellow)

- 0 Minimal - Materials that are normally stable, even under fire conditions and will not react with water.
- 1 Slight - Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but they will not release energy violently.
- 2 Moderate - Materials that, in themselves, are normally unstable and that readily undergo violent chemical change, but will not detonate. These materials may also react violently with water.
- 3 Serious - Materials that are capable of detonation or explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation; or materials that react explosively with water.
- 4 Severe - Materials that are readily capable of detonation or explosive decomposition at normal temperatures and pressures.

PERSONAL PROTECTION (White)

The white section on the HMIS label is used to indicate what personal protective equipment should be used when working with the material, whereas on the HFPA label the white area is used to identify special hazards. Information provided by the manufacturer/supplier is used to determine the proper personal protective equipment. This is represented by a letter coding system which refers to a series of protective equipment configurations.

- A Safety Glasses
- B Safety Glasses and Gloves
- C Safety Glasses, Gloves and an Apron
- D Face Shield, Gloves and an Apron
- E Safety Glasses, Gloves and a Dust Respirator
- F Safety Glasses, Gloves, Apron and a Dust Respirator
- G Safety Glasses, Gloves and a Vapor Respirator
- H Splash Goggles, Gloves, Apron and a Vapor Respirator
- I Safety Glasses, Gloves and a Dust/Vapor Respirator
- J Splash Goggles, Gloves, Apron and a Dust/Vapor Respirator
- K Air Line Mask or Hood, Gloves, Full Suit and Boots
- L – Z Custom PPE specified by employer

CHRONIC EFFECTS INFORMATION

Chronic health effects are not rated because of the complex issues involved and the lack of standardized classifications and tests. However, based on information provided by the manufacturer/supplier, chronic effects may be indicated by (1) use of an asterisk (*) or other designation after the Health hazard rating corresponding to other information that may be available; or (2) written warnings in the upper white section of the HMIS label.

5. Signs For Safety And Fire Equipment

Location signs for emergency showers, emergency eyewashes, and First Aid equipment are prominently displayed.

All First Aid, emergency shower, and emergency eyewash signs are green and white.

Location signs for fire extinguishers, emergency exits, and other safety equipment are red and white. Signs for fire extinguishers will be fixed to the wall or project from the wall directly above the fire extinguishers.

6. Special Or Unusual Hazards

Warnings at areas or equipment where special or unusual hazards exist will consist of "DANGER", "CAUTION" or "WARNING" signs. Examples include the SRC Chemical Storage Building and the SRC Power Room. "CAUTION" signs are indicated by the colors yellow and black, "WARNING" signs are orange and black, while "Danger" signs are red and black.

Floor tape and/or traffic chain will be used to indicate where traffic may enter.

Black/white or solid white floor tape to indicate aisleways.

Red/white floor tape to indicate fire fighting equipment.

Yellow or yellow/black floor tape to indicate caution areas. Solid yellow tape also indicates boundaries of Aladdin beamlines.

Magenta/yellow chain to indicate a radiation hazard area.

Yellow chain to indicate a caution area.

"CAUTION"-Denotes a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.

"WARNING"-Denotes a potentially hazardous situation that, if not avoided, could result in death or serious injury.

"DANGER"-Denotes an imminently hazardous situation that, if not avoided, will result in death or serious injury.

Laser use areas are indicated by the use of appropriate "CAUTION" or "DANGER" signs.

7. Sirens And Sound Alarms

Sirens and lights will be used for evacuation of the SRC vault prior to injection.

SRC and CNTech emergency alarms are sounded through a loud bell. The PSL and Gas Target emergency alarms are sounded through a loud horn.

Chapter 13. Emergency Procedures, Spills, Accidents and Accident Reporting

1. Emergency Procedures Plan

Emergency procedures are posted throughout the KRC. It includes procedures for medical, fire, and chemical emergencies. All accidents are to be reported to the Dane County Emergency Services, 911. The designated assembly point for emergencies is the PSL parking lot.

Emergency Procedures

In case of Fire:

Anyone who sees a fire or who detects a fire hazard that may suddenly develop into an actual fire should immediately pull a fire alarm (Alarm are located at all exits of buildings).

When a building fire alarm (loud bell or horn) sounds, all persons shall leave the building. If possible, make a "head count" at the designated assembly area (PSL parking lot). No one shall enter the building until the Stoughton Fire Department permits reentry.

Upon hearing the alarm (loud bell or horn), the Operator on Duty [SRC] or other KRC supervisory staff should announce on the paging system, "Evacuate building. There is an emergency".

In case of fire, the Operator on Duty [SRC] or other KRC supervisory staff sole responsibility is to announce on the PA, "There is an emergency. Please evacuate the building immediately."

After this is announced, all personnel, including the Operator on Duty, shall evacuate the building. Do not investigate the alarm as it may place personnel in danger. If possible, during the evacuation, note the alarm zone lit on the fire alarm panel. Any information regarding the emergency that we can provide to the Stoughton Fire Department may be crucial.

As all personnel evacuate, the Operator on Duty [SRC] or other KRC supervisory staff should be informed of the emergency's nature.

Call 911 from a safe location to verify the emergency, if possible. Give specific and accurate details to them. If possible, normal electric power to the area should be turned off.

Fire fighting action should be taken only by personnel in the immediate area of the fire, if this can be done with reasonable safety. Use Class D fire extinguishers for metal fires only.

Otherwise, use Class ABC (wood/paper, electrical, and flammable liquid) Halon or dry chemical fire extinguishers or Class BC carbon dioxide fire extinguisher.

Assist the Stoughton Fire Department if requested to do so.

In case of a Hazardous Chemical Spill:

In case of contact with a toxic chemical, call the Dane County Emergency Services, 911. First Aid manuals for chemical emergencies are located where first aid supplies are stored. The University Hospital Poison Control Center phone number is 9-262-3702.

If a member of the Operations Group [SRC] or other KRC supervisory staff is present Notify persons in the area to evacuate.

Any personnel present should trigger the fire alarm to indicate an emergency.

Upon hearing the alarm(loud bell or horn), the Operator on Duty [SRC] or other KRC

Supervisory staff should announce on the paging system, "Evacuate building. There is an emergency".

The SRC vault emergency ventilation may be initiated during the evacuation by Operations Group personnel present (only if safety and time allows).

As all personnel evacuate from their building, the Operator on Duty [SRC] or other KRC supervisory staff should be informed of the emergency's nature.

Evacuate to the PSL parking lot. Avoid being downwind of the chemical spill. If possible a "head count" will be made in the designated assembly area (PSL parking lot).

Do not reenter the affected building until authorized by the Stoughton Fire Department.

If no members of the Operations Group [SRC] or other KRC supervisory staff are present (i.e. during the weekend)

Notify persons in the area to evacuate.

Any personnel present should trigger the fire alarm to indicate an emergency.

Upon hearing the alarm (loud bell or horn), all persons must evacuate the building.

If time allows and the hazard is known, announce, "Evacuate the building. There is a chemical spill".

Upon evacuation, all persons shall go to the PSL parking. Avoid being downwind of the spill.

Do not reenter the affected building until authorized by the Stoughton Fire Department.

In case of Medical Emergency:

- A medical emergency is one in which a victim's life may be at risk from the injury. Immediate medical assistance is necessary.
- After verifying a medical emergency [i.e., heart attack, head injury, severe bleeding] shout for help. Do not enter the area if it poses any risk for you (i.e., electrical shock, toxic gas leak, etc.). Assist the victim after you have determined it is safe to approach.
- Send a co-worker to report the emergency to 911. Give detailed information as to the injury and location of the emergency. Do not hang up until the dispatcher hangs up the phone. If a co-worker is not available, call 911 while assisting the victim.
- Stay with the victim until EMS arrives. If trained in first aid, please provide first aid assistance until professional help arrives.
- KRC has volunteers who are Red Cross Certified in Cardiopulmonary Resuscitation and First Aid, and are capable of assisting victims until EMS arrives. Personnel interested in becoming certified in CPR and First Aid please contact the KRC Safety Specialist.
- First Aid equipment is located throughout the KRC. Saline wash bottles may be used to wash chemicals or irritants out of the eyes or off the skin. However, KRC recommends you also seek emergency medical attention. Medical gloves, splints, triangular bandages, stretcher, cold packs, gauze, and insect sting kits, and eye patches are stocked first aid items.

For Exposures to Hazardous Chemicals:

Eye contact: Immediately wash the eyes with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately. Emergency eyewashes are located in the SRC Chemical Storage Building, SRC Chemical Room, SRC Equipment Room, CNTech Process Cleanroom, PSL First

Aid Room, PSL Vacuum Test Area, and PSL High Bay Area. Eyewash saline bottles are located throughout the facilities and may be used as a preliminary step to using an eyewash.

Ingestion: Contact University Hospital Poison Control Center immediately (9-262-3702).

Do not induce vomiting unless advised to do so by the Poison Control Center. Rinse out the mouth with water and spit it out. Drink one to two glasses of milk. Do not give an unconscious person anything to drink. Never give anything to someone who is convulsing. Get medical attention immediately.

Skin Contact: Promptly flush the affected area with water for 15-20 minutes while removing any contaminated clothing. For hydrofluoric acid (HF) burns, flush with water for at least 5 minutes, then apply Calcium Gluconate Gel (the antidote for HF) and seek emergency medical help immediately. Calcium Gluconate Gel is located in the first aid kit in the SRC Chemical Room, above the eyewash in the PSL vacuum area, and inside the first aid kit in the PSL welding area. For any skin contact with corrosive substances, obtain medical attention immediately.

Inhalation: Remove from exposed area to fresh air immediately. If breathing has stopped, give artificial respiration. Maintain an open airway and circulation. Keep affected person warm and comfortable. Get medical attention immediately.

2 Accident Reporting

For KRC Staff:

Employees must report all injuries and/or accidents to their supervisor immediately. The injured employee must complete an Employee Workplace Injury or Illness Report and submit it to the employee's supervisor or the Personnel Director within 24 hours of the incident. The employee's supervisor must complete the Supervisor Section of the Supervisor and Safety Coordinator Investigation Report for Injury or Illness form. Once completed with their portion, the supervisor must forward this form to the Safety Manager for completion. This form must also be returned to the Personnel Director within 24 hours. These forms can be obtained in the Personnel Office or the KRC Safety Specialist and should be completed with the assistance of Personnel staff.

For KRC Users:

Recordable injuries and/or illnesses are to be reported to the KRC Safety Specialist by completing a "Safety Report". It is to be completed and submitted to the KRC Safety Specialist within 24 hours of the injury and/or illness. "Safety Reports" may be obtained from the facility safety officer or the KRC Safety Specialist.

3. Alarm Systems

An alarm system exists to alert all people in the KRC of: accelerator injection, indicated by sirens; fire or chemical emergency, indicated by bells [SRC and CNTech] or horns [PSL and Tomotherapy].

When an emergency alarm sounds, immediately evacuate the affected facility and assemble in the PSL parking lot.

When an alarm is triggered, a signal is sent to the University Department of Police and Security. A dispatcher there will notify 911 (who send the Stoughton Fire Department and Dane County Sheriff's Department) and send a campus police officer to investigate.

4. Spill Control Policy

The Spill Control Policy will include prevention, containment, and reporting. All chemicals have unique problems associated with them, so each chemical must be treated individually.

The chemical spill is to be reported immediately to the facility safety officer. Large or toxic spills must be reported to the Dane County Emergency Services (911), UW Police and Security, and the UW Safety Department.

The spill should be avoided by untrained personnel. If a large spill or release of toxic material occurs, the building must be evacuated and 911 called. Follow the KRC Emergency Procedures.

A "Safety Report" on the incident is to be submitted to the KRC Safety Specialist within one day. The "Safety Report" forms are available from the facility safety officer and must include the date, time, identity of the chemical, quantity, and all other specifics related to the incident.

Spills should be handled in the manner described by the chemical's MSDS. MSDS's are located on the lower level of Aladdin, PSL First Aid Room, and with the KRC Safety Specialist. Personal protective apparel must be worn when cleaning the spill. Contact the KRC Safety Specialist immediately for assistance.

Spilled hazardous chemicals shall not be directed into floor or sink drains or into the soil. Spill booms may be used to contain the spill. Booms are located strategically throughout the KRC.

5. Evaluation of Spills

All accidents will be carefully analyzed with the results distributed to all who might benefit. This will be achieved within the completed "Safety Report". Steps, including engineering controls (i.e., improved ventilation) will be taken to prevent a further occurrence.

A "Safety Report" is to be completed and submitted to the KRC Safety Specialist within 24 hours of all accidents, injuries, or spills.

6. Chemical Spill Procedures

Large and/or Hazardous

Hazardous: Immediately dangerous to human contact through inhalation, ingestion or skin contact.

All large and/or toxic spills must be reported immediately by pulling the fire alarm. Evacuate the buildings immediately. Notify 911 and the UW Safety Department of the chemical spill. The Madison Hazardous Materials Team will arrive and contain/decontaminate the spill. Personnel must not reenter the danger area until it is cleared for use by emergency personnel. Do

not attempt to contain a spill that is immediately hazardous to human life. Example: Toxic gas leak or a fire in the SRC Chemical Storage Building.

Medium, Not-Immediately Hazardous-To-Life

These spills may be handled by onsite staff with UW Safety Department assistance. No evacuation or fire alarm is necessary unless toxic fumes or dangerous conditions (fire, etc.) ensue. The UW Safety Department must be notified (9-262-8769). Protective apparel must be worn by all cleanup personnel. Chemical goggles, aprons, faceshields and gloves (SilverShield gloves will work with most chemicals, refer to the *Quick Selection Guide to Chemical Protective Clothing* in the SRC Chemical Room or KRC Stockroom) are located throughout the KRC. Gloves are located in the same areas as above. Protective suits are in the SRC Chemical Storage Building.

For medium spills, contain the liquid or powder. Use spill booms to contain the spill if needed.

Powders are to be placed in double thickness bags and sent to the UW Safety Department for disposal. Avoid raising dust. Wear a filter mask if needed. Wet powder if needed, but do not use water if the powder is water-reactive. Some powders can be placed in the normal trash.

See the *UW Chemical Safety and Disposal Guide* for specific disposal procedures.

Liquids are to be absorbed or neutralized at the site of the spill. Acids may be contained with spill booms. Use sodium bicarbonate (NaHCO_3) to neutralize the spill. Sprinkle it on the spill from the outer edges inward. When the bubbling has stopped, the residue is safe to dispose. The residue may be dissolved in water and poured down a laboratory sink drain. Always wear protective apparel (wash off with water for fifteen minutes when done). Caution!! This is an exothermic reaction. Sodium bicarbonate is located in lab areas and the KRC Stockroom. Do not use sodium bicarbonate on hydrofluoric acid spills. It will form a toxic material. Carefully add a solution of calcium hydroxide (slaked lime) to a hydrofluoric acid spill.

Solvents may be contained with spill booms. Use Lite-Dri absorbent for solvent spills. When the liquid is solidified, it may be packaged up and sent to the UW Safety Department. Be cautious of vapors generated. Wash off contaminated clothing. Lite-Dri is found in areas of solvent storage.

Bases may be contained with spill booms. Use citric acid (powder) to neutralize the spill. Citric acid is found in lab areas. Once neutralized, the salt may be dissolved in water and poured down a laboratory sink drain. Be cautious, it is an exothermic reaction. Wear proper protective apparel.

Releases of nonhazardous gases may be contained by closing the valve. Alternatively, the leaking gas cylinder may be placed in the fume hood, if there are nonreactive chemicals in the fume hood. The gas cylinder after being sealed or emptied should be sent to the UW Safety Department for disposal. Releases of any quantity of hazardous gas must be treated as a chemical emergency.

Small Spills Not Immediately-Hazardous-To-Life (i.e. 100 ml of solvent or acid)

Treat as above with sodium bicarbonate, Lite-Dri, or citric acid. You do not need to use spill booms or notify 911. The KRC Safety Specialist should be notified to provide assistance, if needed. Some spilled powders can be placed in the normal trash.

See the *UW Chemical Safety and Disposal Guide* for specific procedures. Wear appropriate protective apparel. Refer to the *Quick Selection Guide to Chemical Protective Clothing* in the SRC Chemical Room or KRC Stockroom.

Always wear chemical splash goggles when working with chemicals. Adsorbents and neutralizing agents for solvents, bases, and acids are located in lab areas. Small solvent spills can also be wiped up with a paper towel and then thrown into a RED covered garbage can.

7. Chemical Releases In The SRC Vault - Emergency Ventilation

Immediately Hazardous To Life

Example: release of arsine or other highly toxic chemicals

If A Member of the SRC Operations Group Is Present

- Notify persons in the area to evacuate.
- Any personnel (SRC, PSL, CNTech, or User) should pull the fire alarm to indicate an emergency.
- Upon hearing the alarm (loud bell), the Operator on Duty should then immediately announce, "evacuate the building. There is an emergency".
- The vault emergency vents should be immediately opened upon announcement of a chemical
- Emergency. This may be done by any SRC Operations Group personnel present, but only if safety and time allow.
- As all people evacuate, the OOD should be informed of the emergency's nature.
- Evacuate to the PSL parking lot. Avoid being downwind of the area of the chemical spill.
- Do not reenter the SRC building until authorized by the Madison Hazardous Materials Team or Stoughton Fire Department to do so.
- Notify the SRC Operations Group Leader, SRC Building Manager, SRC Safety Officer, and the KRC Safety Specialist of the incident.

If No Members of the SRC Operations Group Are Present (i.e. during the weekend)

- Notify persons in the area to evacuate.
- Any personnel should pull the fire alarm to indicate an emergency.
- Upon hearing the alarm (loud bell), all persons must evacuate the building.
- If time allows and the hazard is known, announce over the intercom, "evacuate the building. There is a chemical spill".
- Upon evacuation, all persons shall go to the PSL parking lot. Avoid being downwind of the chemical spill.

- Do not reenter the SRC building until authorized by the Madison Hazardous Materials Team or Stoughton Fire Department to do so.
- Notify the SRC Operations Group Leader, SRC Building Manager, SRC Safety Officer, and the KRC Safety Specialist of the incident.

Not Immediately Hazardous To Life

Example: a seized turbomolecular pump releasing burnt pump oil fumes

If A Member of the SRC Operations Group Is Present

- If the chemical release is determined to be a toxic chemical release, immediately follow the emergency procedures. If it is not immediately hazardous to life, do the following:
- Notify the OOD of the chemical release, detection of chemical odor, or suspected chemical release. The Operations Group has the authority to open the emergency vents in emergencies and non-emergencies.
- Notify the KRC Safety Specialist of the incident. He will investigate.
- If the Safety Officer is absent, decisions will be left to the Operations Group judgment.
- Any chemical release that is noxious or could pose a health concern, would necessitate the emergency vents being opened. Always weigh health concerns as more important than maintaining constant air temperature or preventing disruption to the beam. A list of all chemicals being used by experimenters is posted at the SRC Operations Check-In Desk.
- Only authorized personnel (SRC Operations Group members) may open the emergency vents.
- The vault should be purged and replaced with fresh air approximately twelve minutes after the emergency vents are opened.
- If it is necessary, call for an evacuation of the vault or building, or summon emergency aid (Stoughton Fire Department).

If No Members of the SRC Operations Group Are Present (i.e. during the weekend)

- If the chemical release is determined to be a toxic chemical release, immediately follow the emergency procedures. If it is not immediately hazardous to life, do the following:
- Notify the SRC Operations Group Leader, SRC Building Manager, SRC Safety Officer, and the KRC Safety Specialist of the chemical release, detection of odor or suspected chemical release.
- If it is not immediately hazardous to life, it is up to the discretion of the personnel present to evacuate. Always weigh the effects on health as more important than preventing disruption to the experiment.
- A list of chemicals used by experimenters is posted at the SRC Operations Check-In Desk.

Under all circumstances, the SRC Building Manager, SRC Operations Group Leader, SRC Safety Officer, and the KRC Safety Specialist are to be informed whenever the SRC vault emergency vents are opened.

The KRC Safety Specialist must be notified of all SRC chemical spills, releases, and exposures.

Chapter 14. Information and Training Program

1. Policy

It is KRC's policy to ensure that all individuals at risk are adequately informed about the work at the KRC, its risks, and what to do if an accident occurs. KRC also strives to achieve full compliance with the requirements of the "Hazard Communication Standard" and the "Lab Safety Standard".

2. Emergency and Personal Protection Training

KRC personnel, temporary workers, and Users should know the location and proper use of available protective apparel and equipment.

Fire extinguisher training will be given annually. Fire alarm testing will be performed once per month, with fire drills conducted annually.

A SRC Safety Orientation will be given to all new SRC Users and personnel on the first Tuesday of a quantum, or when needed. It will consist of a two hour training session on SRC Safety Policy in addition to rules and procedures for safe work at the SRC. A *KRC Safety Policies and Procedures Manual* and/or *SRC New User Orientation and Safety Booklet* will be given to each attendee.

Chemical handling and disposal training will be given during the SRC Safety Orientation to all personnel who need it. Reference books, MSDS's and safety manuals will also be available 24 hours a day. Detailed training will be given at the time of need.

First Aid and CPR training will be made available to all KRC personnel and Users who desire the training.

KRC personnel, temporary workers, and Users will be instructed in emergency procedures and through information posted throughout the KRC.

All users of PSL forklifts and/or KRC overhead cranes must go through safety training sessions. Upon completion of the class (or classes), users are certified to operate said equipment. Contact the KRC Safety Specialist for further information.

Specialized training in respirator use, confined space entry, fall protection, and bloodborne pathogens safety will be provided to the involved personnel. This training will be conducted annually and when necessary for review.

3. Receiving And Stockroom/Storeroom Personnel

Personnel should know about hazards, handling equipment, protective apparel, and relevant regulations.

Receiving and Stockroom personnel are instructed in hazardous materials handling, transportation, and shipping. Please see Chapter 38 "*Hazardous Material Transportation*".

4. Frequency Of Training

The training programs will be a regular, continuing, informal activity-not simply an annual presentation. Safety videotapes will also be utilized periodically.

The KRC Safety Specialist will present safety recommendations to personnel prior to hazardous duties.

SRC Safety Orientations for new SRC Users or personnel will be performed at least once per quantum. Fire drills and fire extinguisher training will be performed annually. Respiratory protection training will be given annually. Certified first aid and CPR training will be offered annually. Confined space entry training will be given as necessary. Fall hazard and protection training will be given at least once annually. Radiation safety training will be provided during the SRC Safety Orientation. Laue camera safety and operational training will be provided when necessary. Laser safety training will be provided when necessary. Bloodborne pathogens safety training will be provided annually. KRC overhead crane operator training will be provided when necessary. PSL forklift operator training will be provided once each two years. Hazardous materials shipping training will be provided once each three years.

5. Literature and Consultation

Literature concerning occupational health and safety is available to KRC personnel and Users, who should be encouraged to use these information resources.

MSDS files are located in the lower level of SRC, with the KRC Safety Specialist, and in the PSL First Aid Room. They are arranged alphabetically. The MSDS index is located with the KRC Safety Specialist, KRC Stockroom, PSL Safety Officer, in the SRC MSDS file cabinet, and on the safety bulletin boards on the lower level of SRC and PSL Machine Shop.

Standard reference books may be obtained through the KRC Safety Specialist. Some reference books are located in the SRC Chemical Room, SRC Library, and PSL First Aid Room. The *UW Chemical Safety and Disposal Guide* can be found in lab areas of the KRC. It can also be accessed by going to the KRC Safety manual online index and selecting the *UW Chemical Safety and Disposal Guide*.

Facility safety officers will investigate all environmental, safety, and health matters brought to their attention. Contact the UW Safety Department, 9-262-8769, for information if the facility safety officer is unable to provide an answer.

Important information on safety is posted throughout the KRC, with a safety bulletin board adjacent to the SRC Chemical Room and the PSL Machine Shop.

Key cards for NFPA chemical labels are posted throughout the KRC. The key cards explain the hazard classification of each section of the diamond, the numbering system and special hazard symbols.

Copies of the KRC safety manual and/or *SRC New User Orientation and Safety Booklet* are distributed to all KRC staff and SRC users. A copy of the KRC safety manual is located on each beamline and throughout the complex.

Safety videotapes are available for viewing by any KRC personnel or user. Topics include accident prevention, forklift use, electrical safety, and respiratory safety. Contact the KRC Safety Specialist for the list of available videotapes.

6. Inventory of Hazardous Chemicals

Uw Safety Department Right-To-Know Survey

This inventory contains the list of toxic substances regulated under the Hazard Communication Standard, which have been used or stored at the KRC the previous year.

These files are kept with the KRC Safety Specialist and are posted at SRC and PSL.

SRC Chemical Storage Building Inventory

This inventory is the current listing of all chemicals stored in the SRC Chemical Storage Building. The inventory is organized according to the chemical's hazard classification.

This file is kept in the SRC Chemical Storage Building and with the KRC Safety Specialist.

Cntech Process Cleanroom

An inventory of chemicals stored in the CNTech Process Cleanroom is posted at the door to the cleanroom.

Chapter 15. Material Safety Data Sheets (MSDS)

Policy

KRC will obtain and maintain files of Material Safety Data Sheets for hazardous material in use, previously used, or stored at the KRC. Personnel shall have access to MSDS's at all times and be instructed in the importance of MSDS's and how to obtain and interpret an MSDS. This will be accomplished at the Safety Orientation for New Users/Staff.

MSDS's

Material Safety Data Sheets (MSDS) are an important component of hazard communication. MSDS's provide information about the material or chemical substances within a product, health hazard information, physical properties, safe handling procedures, first aid measures, and procedures to be taken when the product is accidentally spilled or released. Specific sections and their contents are discussed below.

The KRC is required by OSHA's "Hazard Communication Standard" and Wisconsin's "Public Employee Safety and Health" to have an MSDS for each hazardous material present at the KRC. Hazardous chemicals include the hydrogen gas a User works with, the welding electrodes used in the PSL Machine Shop, the solvents used to clean UHV parts, and the toilet bowl cleaner the custodians use. Essentially any chemical or product present in a facility that may pose a health or safety risk to personnel must have an MSDS available for personnel to educate themselves on its hazards and how to protect themselves. KRC strongly recommends that all staff and Users obtain and read the MSDS for each chemical or product personnel use prior to working with the chemical or product.

KRC has done several things to make it easier for personnel to access MSDS's. SRC has a file cabinet on the lower level of Aladdin with its complete file of MSDS's. The sheets are in alphabetical order and an index is available. The KRC Safety Specialist also maintains duplicate sheets in his office. SRC places on each beamline a folder containing a copy of the MSDS's for each chemical the Principal Investigator has informed SRC that he/she will be using. It is the blue folder marked "MSDS's for Chemicals on this Beamline", and is located on or near the front end control panel. Finally, SRC's website has a link to an MSDS information website, which may be used to search for an MSDS SRC does not have or to research a chemical you are contemplating use. To use the MSDS information website, go to SRC's website, select "Quick Links", select "Safety Web", and select "MSDS". Other World Wide Web safety and/or MSDS resources may be located by referring to the World Wide Web Safety Resources listed at the front of the safety manual. PSL has a file cabinet in the First Aid Room with its complete file of MSDS's. The sheets are in alphabetical order and an index is available. The KRC Safety Specialist also maintains duplicate sheets in his office. CNTech maintains its files of MSDS's with the SRC files.

If you are still unable to find an MSDS for a chemical or product, contact the KRC Safety Specialist for assistance.

There are generally about ten sections. Manufacturers may arrange the information in their MSDS's as they wish, but information on a MSDS should include the following:

Manufacturer Information

The manufacturer's name, address and phone number must be listed. An emergency phone number to contact for spills, exposures, or any other emergency information pertaining to the chemical or product must also be listed. The date the MSDS was prepared and by whom will be indicated. If new information is discovered with regards to the chemical or product, an updated MSDS is supplied. Ensure that the MSDS you read is the most up to date. The name of the chemical or product as it appears on the container label will be given. All of this information must be present on an MSDS.

Material Identification

The chemical and common names of all ingredients which have been determined to be reportable health hazards are listed. If the hazardous chemical is a single substance, its chemical name and common names are listed. If the hazardous chemical is a mixture, the chemical and common names of the ingredients that contribute to hazards and the common name for the mixture are listed as well as the percentage make-up of the mixture.

CAS Number- A serial number assigned to a specific chemical.

Regulatory information regarding legally allowable exposure concentrations will be provided. OSHA enforces limits it sets for chemical exposures, upon the recommendations of health and safety organizations. OSHA PEL values and ACGIH TLV values are given. Any other recommended exposure limits will be included in this section.

OSHA PEL (Permissible Exposure Limit) - An exposure limit established by OSHA. It generally refers to the level of exposure a human may be exposed to a chemical for 8 hours per day, 40 hours per week without adverse health effect.

ACGIH TLV (Threshold Limit Value) - A term used by the American Conference of Governmental Industrial Hygienists to express the concentration of a material to which persons may be exposed day after day without adverse effects.

OSHA STEL (Short Term Exposure Limit) - An exposure limit established by OSHA. It generally refers to the level of exposure a human may be exposed to a chemical for a short period of time, generally 15 minutes without adverse health effect.

Physical Characteristics

This data tells what the material or mixture is like and how it behaves. A physical description of the chemical will be given also.

Boiling Point- Refers to the temperature at which a material goes from liquid to vapor state.

Vapor Pressure- Indicates how much vapor the material may give off. A high vapor pressure indicates that a liquid will evaporate easily.

Vapor Density- Tells how heavy the pure gaseous form of the material is in relation to air. High vapor densities cause serious problems because the vapors will collect at the bottom of tanks.

Water Solubility- Indicates the solubility of the material in distilled water.

Specific Gravity- Shows how heavy the material is compared to water and whether it will float or sink.

Water Reactive- Indicates if the chemical reacts with water to release a gas that is flammable or a health hazard.

Freezing Point/Melting Point- The temperature at which a material changes from liquid to solid, or solid to liquid.

pH- A value presenting the acidity or alkalinity of an aqueous solution. The scale goes from 1 to 14 with 7.0 being neutral, less than 7.0 acidic, more than 7.0 alkaline.

Volatiles, percentage by volume- The percentage of a liquid or solid that will evaporate at room temperature.

Appearance and Odor- If a chemical or mixture has a distinctive odor, color, or physical state (solid, liquid, or gas) it will be listed.

Fire and Explosion Hazard Data

This section provides the recommended extinguishing media to be used in a fire, together with any unusual fire and explosion hazards. If the chemical emits toxic fumes while being heated or burned, this information will be included under “Unusual Hazards”.

Pyrophoric- A substance that burns spontaneously in air at a temperature of 130°F (54°C) or below.

Flammable- A flammable liquid is defined as a liquid with a flash point below 100°F (38°C) Solids that will ignite readily or are liable to cause fires under ordinary conditions are classed as flammable solids.

Combustible- A term used to classify liquids on the basis of a flash point range of 100°F (38°C) to 200°F (93°C).

Flashpoint- The temperature at which a liquid will give off enough flammable vapor to ignite in the presence of an ignition source.

Autoignition Temperature- Refers to the minimum temperature needed to cause self-sustained combustion in the absence of a spark or flame.

Flammable Limits in Air- Reports the range of gas or vapor concentrations (percent by volume of air) which will burn or explode if an ignition source is present.

Extinguishing Media- Gives the fire fighting extinguishing media suitable for use on the burning material. For instance water, dry chemical, or sand.

Unusual Fire and Explosion Hazards- Indicates if the material presents an unusual hazard and any special conditions that might affect them, including toxic fumes generated.

Reactivity Hazard Data

This information will aid in safe storage and handling of hazardous or unstable materials. Specific hazards regarding its stability, reactivity, and decomposition products will be provided. Chemicals that it is reactive or incompatible with will be indicated.

Stability- Unstable (reactive) means a chemical which, in the pure state, will polymerize, decompose, condense or self-react under condition of shock, pressure or temperature.

Incompatibility- Provides information on common materials with which a severe reaction would occur. Examples would include water or oxidizers.

Hazardous Decomposition Products- Hazardous materials produced in dangerous amounts by burning, oxidation or heating are listed.

Conditions to Avoid- Safe storage requirements, work area conditions, temperature or air sensitivities, and shelf lives may be listed here.

Health Hazard Data

The consequences of exposure by inhalation, skin or eye contact, or ingestion are outlined in this section. The signs, symptoms and effects that the exposure could produce are described so that any exposure would be quickly recognized and appropriate action taken. The organs that are more susceptible to attack are listed as target organs. The effects and damage that exposure could produce are given together with the symptoms. First aid measures must also be provided. Animal testing may be done on hazardous materials. If toxicology results are available, they will be listed in this section. Common abbreviations for toxicology results include:

IHL- inhalation

SKN- skin absorption

ORL- ingestion

EYE- eye absorption

RBT- rabbit specimen

MUS- muskrat

MAM- unspecified mammal

SEV- severe

MOD- moderate

If you have any questions about medical terms listed in this section, please contact the KRC Safety Specialist.

Symptoms of Exposure- Physical signs of an exposure to the chemical will be listed. Signs may include stomach pains, vomiting, dizziness, wheezing or burning sensation.

Acute Effect- An adverse effect resulting from a single exposure with symptoms developing immediately or shortly. The effect is usually of short duration.

Chronic Effect- An adverse effect resulting from repeated low level exposure, with symptoms that develop over a long period of time.

Inhalation- Exposure to a chemical through breathing in fumes, vapors, gases, particulates, or aerosols. The initial target would be the lungs and respiratory system. As the chemical is absorbed by the body, toxic effects may spread.

Ingestion- Exposure to a chemical through eating or drinking the chemical. The initial target would be the digestive system. As the chemical is absorbed by the body, toxic effects may spread.

Skin absorption- Exposure to a chemical by permeation through the skin or direct physical contact, i.e. chemical burn. As the chemical is absorbed by the body, toxic effects may spread.

Corrosive- A liquid or solid that causes visible destruction in human skin tissue.

Irritation- An inflammatory reaction of the eyes, skin, or respiratory system.

Allergic Sensitization- A process where, on the first exposure, no reaction occurs, but on which subsequent exposures will cause a reaction.

Teratogen- A substance which causes malformation in the skeleton or soft tissue of a fetus.

Mutagen- A substance capable of altering the genetic material in a living organism.

Carcinogen- A substance capable of causing or producing cancer in humans.

Lethal Dose 50% (LD₅₀) - The concentration of the chemical or product which has been determined in toxicological studies to be lethal to 50% of the exposed population. The LD₅₀ value will also indicate the species of the target population.

Emergency first aid procedures indicate the immediate steps to be taken in case of eye contact, skin contact, inhalation or ingestion. These are emergency procedures only and the victim should be examined by a doctor as soon as possible. Procedures for removing contamination from skin and eyes, neutralization if recommended, treatment for inhalation, and what to do in case of ingestion are given.

Control and Protective Measures

The proper use of personal protective equipment is of the utmost importance and the guidelines presented in this section must be followed closely. Descriptions of specific equipment (goggles, gloves, respirators, etc.) required for routine use are given. Use of some materials may require specific ventilation requirements. Specific procedures for the safe handling of the chemical will be described, including ventilation, type of respirator if necessary, and type of gloves.

General Exhaust- A system for exhausting air containing contaminants from a general work area.

Local Exhaust- A system for capturing and exhausting contaminants from the air at the point where produced.

Hygroscopic- Property of a chemical to absorb moisture from the air.

Precautions for Safe Handling and Use/Leak Procedures

This section provides important information for handling and storing a material. It also provides information on waste disposal and spill control. Specific equipment and/or a description of the steps to take to clean up a chemical spill will be described. Specific procedures to follow for proper disposal will be outlined. It is important that all recommendations be followed.

Spill or Leak- Any applicable precautions to be taken in the event of spills or leaks are given. Special equipment used for cleanup are listed. Also, given are specific absorbents, neutralization materials, decontamination materials, etc.

Waste Disposal- Gives methods for disposal of spilled solids or liquids. Methods must follow federal, state and local regulations.

Precautions- This section gives any special precautions to be taken in storage and handling. Conditions for storage are also given.

Transport Information

Information on legal requirements for transportation of this material on roads, railways, waterways, or in the air will be provided. Labeling, placarding, and documentation requirements will be listed. For United States Department of Transportation regulation compliance, the chemical's shipping name, hazard class, UN number, and packing group will be indicated.

US DOT- The United States Department of Transportation regulates transportation of chemicals by road, rail, and air. [The United States Coast Guard regulates transportation by water.]

Placard- Sign attached to the exterior of vehicle transporting chemicals, indicating the chemical's specific hazards.

Label- Sign affixed to the chemical's box, indicating the chemical's specific hazard.

Shipping Name- Official US DOT identification of the chemical being shipped. Some chemicals do not have a specific name, i.e. aerosol spray paints, and would be given a general shipping name pertaining to the chemical's general properties.

Hazard Class- Numerical code for the specific hazards of a chemical. For instance, a flammable liquid would have a Hazard Class 3.

UN Number- The US DOT assigns a four digit number to each chemical. Some chemicals which do not have a specific UN Number, will be assigned a general UN Number reflecting the chemical's general properties.

Packing Group- Chemicals shall not be shipped with incompatible chemicals. The Packing Group will indicate which chemicals may be transported in the same vehicle.

Regulatory Information

This section will indicate any regulatory information with regards to the "Clean Air Act", "Clean Water Act", "Resource Conservation and Recovery Act", "Toxic Substances Control Act", or the "Emergency Planning and Community Right to Know Act" (SARA Title III). State regulatory information will be provided. The carcinogenic status of the chemical will be reported.

If you have any questions about the above mentioned Acts, please contact the KRC Safety Specialist.

Chapter 16. Laboratory Waste Disposal Program

1. Policy

KRC's waste disposal program will ensure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals. KRC will comply with US Environmental Protection Agency (EPA) and Wisconsin Department of Natural Resources (DNR) regulations concerning waste disposal and chemical spills.

2. Program

The UW Waste Disposal Program specifies how hazardous laboratory waste is to be collected, segregated, stored, and transported. Transport of waste from the KRC must be in accordance with US Department of Transportation (DOT) regulations. The UW Waste Disposal Program is adhered to by the KRC.

3. Discarding Chemical Stock

All organic solvents are to be placed in the appropriate waste solvent carboy. Square carboys are for halogenated solvents, such as trichloroethane or EnSolv. Round carboys are for nonhalogenated solvents, such as ethanol or acetone. Waste carboys are located within the SRC Chemical Room, in the CNTech Process Cleanroom, and in the Vacuum Test Area of the PSL.

Acids and bases are to be neutralized and diluted prior to disposal down a laboratory sink. Refer to the *UW Chemical Safety and Disposal Guide*. Base and acid neutralizers are located in the SRC Chemical Room and in the PSL Vacuum Test Area. Ensure that the neutralizing agent is appropriate for the chemical. Some acids, for instance hydrofluoric acid, may be safely neutralized using calcium hydroxide. pH paper is located in the SRC Chemical Room and in the PSL Vacuum Test Area or may be obtained from the KRC Safety Specialist.

Surplus solid, liquid chemicals and gas cylinders are to be packaged securely and shipped to the UW Safety Department. Identities and quantities of chemicals to be shipped are to be recorded on the appropriate forms and attached prior to shipping. Seek assistance from the KRC Safety Specialist.

Some nonhazardous chemicals may be placed in the normal trash. Refer to the disposal section of the *UW Chemical Safety and Disposal Guide*.

Specific procedures for disposal of chemicals are located in the "*Disposal by Chemical*" section of the *UW Chemical Safety and Disposal Guide*. Copies of the *UW Chemical Safety and Disposal Guide* are located in the SRC Chemical Room, SRC Electronics Area and PSL First Aid Room.

Before an employee or User leaves the KRC, chemicals for which that person was responsible should be disposed of properly or returned to the SRC Chemical Storage Building. Chemicals may not be abandoned by users or personnel permanently leaving the KRC.

4. Frequency Of Disposal

Hazardous waste will be removed from the KRC as it is produced and picked up by the UW Safety Department. Contact the UW Safety Department at 9-262-8769 for pickup.

5. Method Of Disposal

The UW Safety Department disposes of organic solvents, hazardous chemicals, and gas cylinders. Many acids, bases, and nonhazardous chemicals may be disposed at the KRC.

Obtain directions on disposal procedures from the *UW Chemical Safety and Disposal Guide* or from the KRC Safety Specialist prior to disposal. Always wear personal protective apparel when working with chemicals.

Indiscriminate disposal by pouring waste chemicals down the drain or adding them to the normal trash for landfill burial is unacceptable and may be a violation of federal and state laws.

Hoods will not be used as a means of disposal for volatile chemicals. Disposal by recycling or chemical decontamination should be used when possible. Surplus chemicals are to be shipped to the UW Safety Department. Waste pump oil is to be placed in waste oil carboys located next to the SRC Machine Shop entrance or in the PSL Flammables Shed. Empty water-treatment chemical containers (Nalco, sulfuric acid) are to be rinsed with water and given to the KRC Safety Specialist.

Neutralization Of Acids Or Bases

Acids

To safely dispose of an acid, the pH should be increased to at least 5.0, following which, the solution may be poured down an appropriate sink, for example the SRC Chemical Room sink. Generally any precipitate formed can be poured safely down the drain. Always flush the solution down the sink with twenty parts water to one part solution.

One can neutralize an acid by using a commercial neutralizer or by using sodium bicarbonate. When using a commercial neutralizer, follow the instructions. Any precipitate formed may need to be disposed separately. To neutralize an acid using sodium bicarbonate, find a suitably large container. Pour the acid into the container, and add sodium bicarbonate slowly. CAUTION!! This is an exothermic reaction, heat will be generated and some spattering may occur. The container may be placed in an ice bath. You may opt to dilute the acid, by first pouring water into the container, and then adding the acid. NEVER POUR WATER INTO AN ACID!! After adding sodium bicarbonate, stir the solution until the fizzing stops. You can test the pH of the solution using the pH paper located in the SRC Chemical Room or PSL Vacuum Test Area. Use a glass stirring rod to dip into the solution, and then touch the end of the stirring rod to a strip of pH paper. Determine the pH using the instructions on the container. Continue to add sodium bicarbonate until the pH is between 5.0 and 9.0, when the solution may be poured down the drain with twenty parts water to solution.

Bases

To safely dispose of a base, the pH should be lowered to at least 9.0, following which, the solution can be poured down an appropriate sink, for example the SRC Chemical Room sink. Generally any precipitate formed can be poured safely down the drain. Always flush the solution down the sink with twenty parts water to one part solution.

One can neutralize bases by using a commercial neutralizer or by using citric acid. When using a commercial neutralizer, follow the instructions. Any precipitate formed may need to be disposed separately. To neutralize a base using citric acid, find a suitably large container for the base. Pour the base into the container, and add citric acid slowly. CAUTION!! This is an exothermic reaction, heat will be generated and some spattering may occur. The container may be placed in an ice bath. You may opt to dilute the base, by first pouring water into the container, and then adding the base. NEVER POUR WATER INTO A BASE!! After adding citric acid, stir the solution until the fizzing stops. You can test the pH of the solution using the pH paper located in the SRC Chemical Room or PSL Vacuum Test Area. Use a glass stirring rod to dip into the solution, and then touch the end of the stirring rod to a strip of pH paper. Determine the pH using the instructions on the container. Continue to add citric acid until the pH is between 5.0 and 9.0, when the solution may be poured down the drain with twenty parts water to solution.

NOTES:

Containers of citric acid, sodium bicarbonate, and commercial neutralizers are stored in the SRC Chemical Room and in the PSL Vacuum Test Area. Always wear appropriate personal protective equipment when neutralizing acids or bases. Chemical goggles, aprons, faceshields, and gloves are located in the PSL Vacuum Test Area and in the SRC Chemical Room. One can also neutralize an acid by using a base, and neutralize a base by using an acid. These processes will form a salt and water, which generally can be safely poured down an appropriate sink, for example the SRC Chemical Room sink. See the KRC Safety Specialist for instructions. Do not use sodium bicarbonate to neutralize hydrofluoric acid. It will form a toxic material. Contact the KRC Safety Specialist for instructions.

Chapter 17. Basic Rules and Procedures For Working With Chemicals

The OSHA "Laboratory Safety Standard" requires that personnel and Users know and follow safe laboratory rules and procedures. In addition to the procedures and the rules mentioned elsewhere in the safety manual, the rules listed below apply.

1. General Rules

The following rules should be used for essentially all laboratory work with chemicals:

Accidents and Spills

Eye contact: Immediately wash the eyes with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately. Emergency eyewashes are located in the SRC Chemical Storage Building, SRC Chemical Room, SRC Equipment Room, PSL First Aid Room, PSL welding shop, PSL Vacuum Test Area, and the CNTech Process Cleanroom. Eye saline wash bottles are located throughout KRC and may be used as a preliminary step to using an eyewash.

Ingestion: Contact the University Hospital Poison Control Center immediately (9-262-3702).

Do not induce vomiting unless advised to do so by the Poison Control Center.

Rinse out the mouth with water and spit it out. Drink one to two glasses of milk. Do not give an unconscious person anything to drink. Never give anything to someone who is convulsing. Get medical attention immediately.

Skin Contact: Promptly flush the affected area with water for 15-20 minutes while removing any contaminated clothing. For hydrofluoric acid (HF) burns, flush with water for 15-20 minutes, then apply a 50:50 epsom salt to water compress until emergency help arrives. Epsom salt is found in the SRC First Aid Locker. For any skin contact, obtain medical attention immediately.

Inhalation: Remove from exposed area to fresh air immediately. If breathing has stopped, give artificial respiration. Maintain an open airway and circulation. Keep affected person warm and at rest. Get medical attention immediately.

Clean-up of chemical spills: Promptly clean-up spills, using appropriate protective apparel and equipment. Proper disposal according to state and federal regulations is required. Contact the KRC Safety Specialist or the UW Safety Department, 9-262-8769, for instructions. The MSDS for the spilled chemical will provide valuable information also. Report the spill to your facility safety officer immediately. Spill booms are located in areas of chemical storage.

Refer to Chapter 13 "*Spills and Accidents*" for chemical spill and accident procedures.

Avoidance of "Routine" Exposure

Facility safety officers, KRC personnel, temporary workers, and Users are to develop and encourage safe habits and avoid unnecessary exposure to chemicals by any route.

All KRC personnel and users are to obtain training in the use of safety equipment if unfamiliar with the safety equipment. Proper training is to be obtained before work with chemicals may begin.

Do not intentionally smell or taste chemicals.

Vent apparatus which may discharge toxic chemicals (mechanical vacuum pumps, etc.) into SRC's beamline exhaust system. A mist filter is to be attached to the pump before it connects to the SRC exhaust system.

Wear chemical-resistant gloves and chemical goggles at all times while working with chemicals.

Use a face shield, respirator and/or an apron when appropriate.

Inspect gloves, filters, chemical goggles, and test glove boxes before use.

Read the MSDS's for all chemicals you are working with, and understand the hazards. Be prepared for emergencies with the chemicals you are handling.

Choice of Chemicals

Use only those chemicals for which the quality of the available ventilation system is appropriate.

Do not use chemicals you are unfamiliar with.

Do not order more chemicals than would be used in the experiment.

Equipment and Glassware

Handle and store laboratory glassware with care to avoid damage. Do not use damaged glassware.

Use extra care with Dewar flasks and other evacuated glass apparatus. Shield or wrap them to contain chemicals and fragments should implosion occur.

Use equipment only for its designed purpose.

Exiting

Wash areas of exposed skin well before leaving the laboratory.

Horseplay

Avoid practical jokes or other behavior which might confuse, startle, or distract another employee or User.

Mouth-Suction

Do not use mouth-suction for pipetting or starting a siphon.

Apparel

Confine long hair and loose clothing near moving machinery.

Wear shoes at all times in the laboratory. Do not wear sandals near heavy machinery or hazardous chemicals.

Personal Housekeeping

Keep the work area clean and uncluttered, with chemicals and equipment labeled with NFPA labels and properly stored.

Clean up the work area on completion of a task, experiment, or at the end of each day.

Label all chemical containers with their contents and ownership.

Unlabeled chemicals or clutter may be disposed by KRC personnel at their discretion.

Personal Protection

Appropriate eye protection must be worn by all personnel, including visitors, where chemicals are stored or handled.

Wear appropriate gloves when the potential for contact with toxic materials exists. Refer to the *Quick Selection Guide to Chemical Protective Clothing* in the SRC Chemical Room or in the KRC Stockroom.

Inspect chemical gloves before each use, wash them before removal, and replace them periodically.

Use appropriate respiratory equipment when air contaminant concentrations are not sufficiently controlled by local exhaust, inspecting the respirator or filter before use.

Use any other protective and emergency apparel and equipment as appropriate.

Avoid use of contact lenses in the laboratory. If they are used, inform supervisors so special precautions can be taken.

Remove exposed clothing immediately upon significant contamination.

Planning

Seek information and advice about hazards from the facility safety officer, KRC Safety Specialist, or supervisors; plan appropriate protective procedures; and plan positioning of equipment before beginning any new operation.

Read the MSDS for all chemicals used.

Plan for possible emergencies and make preparations for potential emergencies, i.e., gas cabinets, spill booms, etc.

Unattended Operations

Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as a hot plate) to an unattended operation.

All chemical containers must be labeled with the owner's identity and name of the chemical. The use of NFPA labels is mandatory.

No personnel will be allowed to work alone with hazardous chemicals or equipment.

Use of Fumehoods

Use the hood for operations which might result in release of toxic chemical vapors or dust.

As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a Threshold Limit Value (TLV) or Permissible Exposure Limit (PEL) of less than 50ppm.

Confirm adequate hood performance before use.

Do not store materials in fumehoods other than while working in the hood.

Do not allow materials to block vents or airflow.

Keep the hood sash below the "100 linear feet per minute" mark at all times.

Leave the hood "ON" when it is not in active use if toxic substances are located in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "OFF".

Vigilance

Be alert to unsafe conditions and see that they are corrected when detected.

Notify the facility safety officer, KRC Safety Specialist, or your supervisor concerning unsafe conditions.

Waste Disposal

KRC's Waste Disposal Program is discussed in Chapter 16.

Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan.

Do not discharge to the sewer concentrated acids or bases; highly toxic substances; or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow.

Carboys are available for disposal of waste organic solvents. The carboys are located in the SRC Chemical Room, CNTech Process Cleanroom, and in the PSL Vacuum Test Area.

Contact your facility safety officer or the KRC Safety Specialist with any questions concerning waste disposal.

Copies of the *UW Chemical Safety and Disposal Guide* can be found in the SRC Electronics Area, SRC Chemical Room, and PSL First Aid Room. The "*Disposal by Chemical*" section of the *UW Chemical Safety and Disposal Guide* details specific disposal procedures.

Working Alone

See Chapter 40, *SRC Working Alone/Two Person Rule* for details.

Transport of Chemicals

Transport all containers of hazardous and/or corrosive chemicals in a bottle carrier if possible. Bottle carriers can be found in the SRC Chemical Storage Building and in the SRC Chemical Room.

Lecture bottle gas cylinders may be transported by hand. All other size gas cylinders are to be transported by handcart (chained to the handcart).

Chapter 18. Flammable or Combustible Liquids and Solids

1. Policy

To prevent health and safety hazards through proper management of flammable or combustible liquids and solids. To establish safe procedures for the use and storage of flammable or combustible liquids or solids. To ensure proper disposal of flammable or combustible liquid or solid waste by adhering to the University of Wisconsin waste disposal procedures. Compliance with NFPA 45 “Fire Protection for Laboratories Using Chemicals”, NFPA 30 “Flammable and Combustible Liquids Code”, and COM 32 “Public Employee Safety and Health” will be enforced.

2. Definitions

Flammable Liquid- A liquid having a flash point below 100°F (38°C), and are known as Class I liquids. Class IA shall include those having flash points below 73°F (23°C) and having a boiling point below 100°F (38°C). Class IB shall include those having flash points below 73°F (23°C) and having a boiling point at or above 100°F (38°C). Class IC shall include those having flash points at or above 73°F (23°C) and below 100°F (38°C).

Combustible Liquid- A liquid having a flash point at or above 100°F (38°C). Class II shall include those having flashpoints at or above 100°F (38°C) and below 140°F (60°C). Class IIIA shall include those having flash points at or above 140°F (60°C) and below 200°F (93°C).

Class IIIB shall include those having flash points at or above 200°F (93°C).

Flammable Solid- A solid, other than an explosive, that can cause fire through friction, absorption of mixture, spontaneous chemical change, or retained heat from manufacturing or processing, or that can be readily ignited, and when ignited, will continue to burn or be consumed after removal of the source of ignition.

Flash Point- The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite.

Oxidizer- A chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

Pyrophoric Material- A chemical substance or mixture that will ignite spontaneously in dry or moist air at or below 130°F (54°C)

3. Storage

Laboratory Storage (SRC Chemical Room, CNTech Process Cleanroom)

- Storage of flammable liquids in the SRC Chemical Room is limited to safety cans and/or small containers of flammable liquids. No other long term storage of flammable liquids is allowed in the SRC Chemical Room.
- Ultrasonic baths in the SRC Chemical Room may contain flammable or combustible solvents.
- Both the SRC Chemical Room and CNTech Process Cleanroom are classified as Intermediate Hazard Laboratory Units [Class B]. Under this classification, labs are limited in the quantity of flammable and combustible liquids permitted in the room.

Laboratory Unit or Class	Flammable or Combustible Liquid Class	Quantities Outside Storage Cabinets or Safety Cans	Total Quantities in Cabinets, Cans, and Lab
"B"	I(only)	5 gallons*	10 gallons*
"B"	I, II, IIIA(total)	10 gallons*	20 gallons*

* maximum quantity per 100 square feet of laboratory unit

SRC Chemical Storage Building

- Storage of flammable and combustible liquids and solids is found on the second floor.
- All liquid and solid chemicals are to be contained in flammable chemical cabinets or the chemical refrigerator. All chemical cabinets meet DOC/OSHA and NFPA requirements.
- Each cabinet storing flammable chemicals will be grounded.
- Storage cabinets may not contain more than 60 gallons of Class I and II flammable liquids.
- Cabinets must be inventoried of their contents.
- Glass containers shall not exceed 1 gallon for Class I or II liquids.
- Safety cans shall not exceed 5 gallons for Class IB, IC, II and III liquids.
- All containers are to be covered or sealed.
- All containers must be NFPA labeled.
- MSDS's for each flammable or combustible liquid must be on file with the KRC Safety Specialist.
- Notification is to be given to the KRC Safety Specialist for all incoming chemicals.

SRC General Work Areas

- Maintain the smallest amount of flammable and combustible liquids possible outside of flammable liquid storage cabinets.
- Commonly used solvents should be stored in NFPA labeled wash bottles not to exceed 500 ml.
- Do not store flammable liquids in glass containers on the floor or in locations where the container may break.
- Place stocks of flammable liquids in flammable liquid storage cabinets at the end of the day.
- Each cabinet storing flammable chemicals will be grounded.
- There is no storage of user chemicals allowed in the SRC vault.
- MSDS's for each flammable or combustible liquid must be on file with the KRC Safety Specialist.
- Notification is to be given to the KRC Safety Specialist for all incoming chemicals.

PSL Flammables Shed

- Large containers of flammable or combustible solvents are stored here.
- Carboys of waste solvents are stored until pickup by UW Safety.
- Ensure proper documentation is attached to each carboy, barrel, or container.
- Dispensing of liquids may be done only into safety cans.
- Wear the appropriate protective apparel when dispensing.
- Dispensing of Class I liquids (i.e., acetone) is to be done while using a ground strap, connecting the 55 gallon barrel to the safety can.
- All hazardous materials are to be stored upon the containment pallets.
- Spill control materials are stored in the PSL Flammables Shed.

- Each barrel of flammable liquid is to be grounded to the building.
- The PSL Flammables Shed will be grounded.
- The key for the shed may be obtained from the KRC Safety Specialist or the KRC Stockroom.

4. Use Of Flammable Or Combustible Chemicals

Procurement

- If ordering hazardous materials for shipment to the KRC, notification is to be sent to the KRC Safety Specialist. Incoming chemicals will not be released for use until the KRC Safety Specialist has received notification.
- Common solvents and acids may be provided by SRC, CNTech, or PSL.
- Ensure that MSDS's are on file at the facility. Contact the KRC Safety Specialist. You will not be allowed to use a chemical if an MSDS is not on file.
- When the chemical arrives, the KRC Safety Specialist will attach an NFPA label and add the chemical to the inventory if it will be stored in SRC's Chemical Storage Building.

Handling

- Read the MSDS for each chemical. Follow the guidelines.
- Wear the appropriate protective apparel. Wear chemical splash goggles and protective gloves.
- Chemical splash goggles, gloves, face shields and aprons may be found throughout the KRC and may be checked out from the KRC Stockroom.
- Refer to the *Quick Selection Guide to Chemical Protective Clothing* in the SRC Chemical Room or KRC Stockroom for the appropriate gloves to wear.
- Keep flammable or combustible liquids or solids separate from oxidizers during storage or use.
- If possible, do all work with flammable or combustible liquids or solids in a fumehood. Only work with solvent wash bottles should be conducted outside of a fume hood.
- Ensure adequate airflow in the fume hood. Contact the KRC Safety Specialist immediately if airflow is not adequate. An airflow of 100 linear feet per minute is adequate for most solvents. - A mark indicating 100 lfm flow rate is on the sash of KRC fume hoods.
- Only heat flammable or combustible liquids or solids on a hot plate. Do not use an open flame.
- Never dry a flammable or combustible liquid or solid in an oven.

5. Waste Disposal

Solvent Carboys

- Waste solvents are to be collected in carboys located in the SRC Chemical Room, CNTech Process Cleanroom, and in the PSL Vacuum Test Area.
- Halogenated solvents (i.e., EnSolv) are placed in the square carboys.
- Non-halogenated solvents (i.e., acetone, ethanol) are placed in the round carboys.
- A *UW Chemical Safety and Disposal Guide* is located in the SRC Chemical Room, SRC Electronics Area, and PSL First Aid Room.
- Solvents, other than the common solvents provided by KRC, if disposed are to be entered on the green waste solvent form attached to each carboy.

Waste Oil

- Waste motor oil is collected and disposed separately from waste lab chemicals.
- Waste lubricating, penetrating, or machine tool gearbox oil is collected and disposed separately from waste lab chemicals.

- Waste mechanical pump oil is collected in carboys.

Other Flammable and Combustible Chemicals

- May be given to the KRC Safety Specialist for packaging and disposal.
- Provide the KRC Safety Specialist with identification and volume of chemical to be disposed.
- Leaking containers must be placed in secondary containment.

6. Spills and Accidents

Refer to Chapter Thirteen, *Spills and Accidents* for instructions on cleaning up spills of flammable or combustible chemicals.

Chapter 19. Working With Allergens and Embryotoxins

1. Allergens (examples: diazomethane, isocyanates, bichromates)

Wear suitable gloves and lab aprons to prevent skin contact with allergens or substances of unknown allergenic activity. Wear chemical goggles. Safety glasses are not adequate protection from a splash.

2. Embryotoxins (examples: organomercurials, lead compounds, formamide)

If you are a woman of childbearing age, handle these substances only in a fume hood where satisfactory performance has been confirmed; and use appropriate protective apparel, especially gloves, to prevent skin contact.

Review each use of these materials with your supervisor, the KRC Safety Specialist, and facility safety officer. Read the MSDS and be familiar with the hazards.

Users are asked to submit a “SRC Experiment Form” at least one month prior to beginning work. Forms are located on the shelf beneath the SRC Staff and User mailboxes or may be submitted electronically from the SRC website or the SRC SafetyWeb page. Include a diagram of any gas handling system (with gas cabinet if using a hazardous gas), and a detailed explanation of how each chemical will be used (including storage, quantity brought to SRC, quantity used in each run, placement into the chamber, general handling, and disposal).

These substances are to be stored, using proper NFPA labels, in an appropriate cabinet separate from incompatible substances, in an unbreakable secondary container.

Notify the facility safety officer, the KRC Safety Specialist, the UW Safety Department and the Dane County Emergency Service, 911, of all incidents of exposure or spills at the KRC.

In all spills, notify your facility safety officer and the KRC Safety Specialist as soon as possible. File a Safety Report within one day of a chemical spill.

Consult a qualified physician when exposed to an embryotoxin.

Chapter 20. Working With Chemicals of Moderate Chronic or High Acute Toxicity

1. Policy

To minimize exposure to toxic substances by any route using all reasonable precautions.

2. Applicability

These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities. Chronic toxicity is a health hazard and/or effect resulting from long-term exposure to a chemical. Acute toxicity is a health hazard and/or effect resulting from a brief exposure.

Examples: disopropylfluorophosphate, hydrofluoric acid, hydrogen cyanide.

Hydrofluoric acid is more hazardous than other acids due to how seriously it can burn. In concentrations less than 50%, hydrofluoric acid may not produce any burns for several hours after contact. Hydrofluoric acid releases fluoride ions into deep tissue layers causing severe burns which are not easily apparent. Medical personnel can misdiagnose HF burns and treat for hydrochloric acid burns.

3. Storage

Store these substances only in a storage cabinet. Material Safety Data Sheets and notification of use must be sent to the KRC Safety Specialist. Lab work with these substances can only be done in the CNTech Process cleanroom, the SRC Chemical Room or other laboratory equipped with a fumehood.

Always use a fumehood, previously evaluated to confirm adequate performance with a face velocity of at least 100 linear feet per minute, or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance. Ensure the fumehood is operating properly before use. Notify the KRC Safety Specialist immediately if the fumehood is not operating properly.

4. Personal Protection

Always avoid skin contact by use of gloves, lab aprons, and other protective apparel as appropriate. Choose the proper glove for the chemical. Different material gloves are available throughout the KRC. Refer to the *Quick Selection Guide to Chemical Protective Clothing* in the SRC Chemical Room or KRC Stockroom. Eye protection, in the form of chemical goggles, must be worn at all times when working with chemicals. Respirators should also be worn if appropriate. Obtain respiratory protection training from the KRC Safety Specialist. See the facility safety officer or the KRC Safety Specialist for training in the use of personal protection devices.

Always wash hands and arms immediately after working with these materials.

5. Records

Records of the types of these materials on hand, amounts used if possible, materials stored in the SRC Chemical Storage Building, and the names of the Users or KRC personnel involved are maintained by the KRC Safety Specialist.

Material Safety Data Sheets (MSDS) for chemicals stored and/or used at the KRC are filed on the lower level of Aladdin, the PSL First Aid Room, and the office of the KRC Safety Specialist. An index is filed in those locations and at all safety bulletin boards.

Safety Reports will be maintained for all incidents involving hazardous chemicals.

6. Prevention of Spills and Accidents

Be prepared for accidents and spills. Be aware of the hazards of each chemical and how to treat a spill involving each chemical. Read the MSDS's for all chemicals used. All spills and/or accidents concerning chemicals are to be reported to the facility safety officer and KRC Safety Specialist immediately.

If a major spill occurs outside the hood, evacuate the area. If hazardous chemicals or gases are involved, use the fire alarm to evacuate the building. Evacuate to the PSL parking lot. Do not re-enter a building of the KRC until the Stoughton Fire Department authorizes re-entry. See Chapter 13 "*Spills and Accidents*". Cleanup personnel MUST wear suitable protective apparel and equipment.

At least two (2) people are to be present at all times if a compound in use is highly toxic or of unknown toxicity. Never work alone with highly toxic compounds.

Store breakable containers of these substances in chemically resistant trays.

With a hydrofluoric acid burn, immediately wash the area with water for 15 minutes. Attach a 50:50 compress of epsom salts and water to the affected area. Epsom salts are located in the SRC First Aid Locker. Report to the Emergency Room of a hospital as soon as possible, telling them it is a hydrofluoric acid burn.

Transport containers of liquid or solid chemicals in bottle carriers, found in the SRC Chemical Storage Building and in the SRC Chemical Room. Lecture bottle gas cylinders may be carried by hand; large cylinders are to be chained to a hand cart and transported in the hand cart.

Hazardous gases used at the KRC are to be contained in a gas cabinet and vented to the exterior of the facility. Hazardous gases used at the SRC are to be contained in a gas cabinet and vented to the SRC beamline exhaust system.

7. Waste Disposal

Thoroughly decontaminate chemically exposed clothing or shoes. If possible, decontaminate by chemical conversion.

Place contaminated waste in closed, suitably labeled, impervious containers. Attach completed UW-Safety "Surplus Chemical" or "Waste Solvent" forms as appropriate. Consult the *"Disposal by Chemical"* section of the *UW Chemical Safety and Disposal Guide* or the KRC Safety Specialist for appropriate disposal procedures.

Do not discharge waste or spilled chemicals to a drain. Contain large spills within spill booms for treatment. Spill booms are located in chemical storage areas.

Chapter 21. Work With Chemicals of High Chronic Toxicity

1. Policy

To minimize exposure to toxic substances by any route using all reasonable precautions. Further supplemental rules to be followed, in addition to all mentioned previously, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance). Chronic toxicity is a health hazard and/or effect resulting from long-term exposure to a chemical.

Examples: dimethylmercury and nickel carbonyl, benzo-a-pyrene, N-nitro-sodiethylamine, other human carcinogens or substances with high carcinogenic potency in animals.

2. Access

Conduct all transfers and work with these substances in a "controlled area", a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substances being used and necessary precautions are taken. Work with chemicals is to be performed in a chemical laboratory equipped with a fumehood.

3. Approvals

Prepare a plan for use, disposal, and/or storage of these materials, especially handling of gases and gas cylinders. If the work will be conducted at SRC, submit this plan with the "SRC Experiment Form" to the KRC Safety Specialist. Include plans for the gas handling and exhaust systems if appropriate. A gas cabinet is to be used with hazardous gases. Failure to submit this form may result in delays coming online. Consult with the KRC Safety Specialist with any plans for use of high toxicity materials.

Material Safety Data Sheets (MSDS) are required for all hazardous chemicals. Submit MSDS's to the KRC Safety Specialist.

4. Non-Contamination/Decontamination

SRC Turbomolecular pumps are only for initial evacuation of experimental chambers. They are NOT to be used to pump gas manifolds or for bakeouts. Decontaminate the controlled area before normal work is resumed there.

5. Exiting

On leaving a controlled area, remove any protective apparel, placing it in an appropriately labeled container, and thoroughly wash hands, forearms, face, and neck.

6. Housekeeping

Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder.

Users and KRC personnel are responsible for their messes. PERSONNEL WILL NOT BE ALLOWED TO REUSE AN AREA IF IT WAS LEFT IN DISORDER.

7. Medical Surveillance

If using toxicologically significant quantities of such a substance regularly (e.g., three times per week) consult a qualified physician concerning desirability of regular medical surveillance.

8. Records

Accurate records of the hazardous substances stored and used at SRC, the dates of use, and names of owners are maintained in the office of the KRC Safety Specialist. Records of hazardous chemicals used in each facility of the KRC within the previous year are maintained by the KRC Safety Specialist.

SRC Users must submit "SRC Experiment Form" prior to beginning the experiment. Material Safety Data Sheets must be submitted for all chemicals used. This information is to be sent to the KRC Safety Specialist.

Inventories of all SRC stored chemicals are kept in the SRC Chemical Storage Building and with the KRC Safety Specialist. An inventory of chemicals stored in the CNTech Process Cleanroom is posted at the door.

Material Safety Data Sheets (MSDS) are filed on the lower level of Aladdin and in the PSL First Aid Room. Indexes are located there and at all safety bulletin boards.

9. Signs and Labels

Assure that the controlled area is conspicuously marked with warning and restricted access signs. All containers of toxic substances MUST be appropriately labeled with identity and warning labels (NFPA type). All chemicals are to be labeled per KRC Safety Policies and Procedures. Any chemicals in violation of this are subject to disposal.

10. Spills

In the event of chemical spill, follow the EMERGENCY PROCEDURES posted throughout the KRC and in this safety manual. Trigger the fire alarm, evacuate the building, and phone the Dane County Emergency Service(911) for large or life-threatening spills. For small nonhazardous spills contact the KRC Safety Specialist or facility safety officer for assistance.

Acid and base neutralizers are located in the SRC Chemical Room, in the SRC Chemical Storage Building, and the PSL Vacuum Test Area. Use vermiculite, Lite-Dri, or sand to absorb solvent spills. Large supplies of acid and base neutralizers and solvent absorbent are located in the SRC Chemical Storage Building, PSL Machine Shop Emergency Equipment Locker, and PSL Nonflammables Storage Area. Spill booms are also located in the SRC Chemical Storage Building, PSL Vacuum Test Area, PSL Nonflammables Storage Area, and PSL Flammables Shed. Wear appropriate protective apparel while working with a chemical spill. Always wear gloves, splash apron, and chemical splash goggles. Check the MSDS for important spill

instructions, and consult the *Quick Selection Guide to Chemical Protective Clothing* in the SRC Chemical Room or KRC Stockroom for appropriate clothing.

A "Safety Report" is to be filed for all spills. The KRC Safety Specialist should receive this form within 24 hours.

11. Storage

Store containers of hazardous chemicals and gas cylinders used at the SRC only in the SRC Chemical Storage Building in appropriately labeled, and unbreakable chemically resistant containers. The identity of the owner and chemical is to be added to the inventory list for each cabinet or shelf within the SRC Chemical Storage Building.

The KRC Safety Specialist is to be notified of the arrival of all hazardous chemicals. Store hazardous chemicals only in appropriate storage cabinets, containers, or storage areas.

An inventory of chemicals stored in the CNTech Process Cleanroom is posted at the door.

MSDS's must be submitted to the KRC Safety Specialist for all chemicals used or stored at the KRC.

12. Glove Boxes

For a negative pressure glove box, the ventilation rate should be at least two volume changes per hour. For a positive pressure glove box, thoroughly check for leaks before each use. In either case, trap the exit gases or filter them through a High Efficiency Particulate Air filter (HEPA) and then release them into an appropriate exhaust system.

13. Waste Disposal

Use the appropriate carboy for waste solvents. Carboys are located in the SRC Chemical Room, CNTech Process Cleanroom, and PSL Vacuum Test Area. Square carboys are for halogenated and hazardous solvents. Round carboys are for nonhalogenated solvents.

Neutralize strong acids and bases, before pouring down a laboratory sink drain with large amounts of water. Acid and base neutralizing agents can be found in the SRC Chemical Room, in the SRC Chemical Storage Building, and in the PSL Vacuum Test Area.

Package waste solids or hazardous chemicals for transport to the UW Safety Department for disposal. Obtain assistance from the KRC Safety Specialist. Gas cylinders may be given to the KRC Safety Specialist for disposal.

Refer to the "*Disposal by Chemical*" section of the *UW Chemical Safety and Disposal Guide* or consult with the KRC Safety Specialist for disposal procedures. Copies of the *UW Chemical Safety and Disposal Guide* are located in the SRC Chemical Room, SRC Electronics Area, and PSL First Aid Room.

Chapter 22. Corrosive Agents

1. Policy

To minimize exposure to these corrosive agents by any route using all reasonable precautions.

2. Applicability

These precautions are appropriate for corrosive substances. Examples: Hydrochloric acid, sulfuric acid, sodium hydroxide, and Oakite

Hydrofluoric acid is much more hazardous. Refer to Chapter 20 for hydrofluoric acid safety.

3. Areas of Use

Handle corrosive agents **ONLY** in a laboratory equipped with a fumehood. Always use a laboratory fumehood or other containment device for procedures which may result in the generation of corrosive vapors.

SRC User owned corrosive agents are to be stored only in a corrosive chemical cabinet of the SRC Chemical Storage Building.

Small quantities of acids and bases are stored in the SRC Chemical Room hood and in the PSL Vacuum Test Area.

Corrosive agents used for SRC water treatment and the CNTech Acid Vapor Scrubber are stored in the SRC Mechanical Equipment Room and Engineering Shed.

4. Personal Protection

Always avoid skin contact through use of gloves and lab aprons. Choose the proper glove when handling corrosives. Refer to the *Quick Selection Guide to Chemical Protective Clothing* in the SRC Chemical Room or in the KRC Stockroom.

Always wash hands and arms immediately after working with corrosive substances.

Wear eye protection at all times when working with corrosive substances. Chemical goggles are the only acceptable type of protective eyewear when handling chemicals. Wear a respirator when appropriate. Obtain respiratory protection training from the KRC Safety Specialist. Consult the KRC Safety Specialist for protection recommendations.

Obtain training if unfamiliar with a particular corrosive agent. Read the MSDS and be familiar with the hazards.

5. Records

Records are maintained for all chemicals stored in the SRC Chemical Storage Building and the CNTech Process Cleanroom.

Users and KRC personnel are to notify the KRC Safety Specialist of all chemicals shipped or brought to the KRC. All chemicals must be labeled with the owner's name, chemical name, and identification of hazards.

Material Safety Data Sheets (MSDS) are collected and filed on the lower level of Aladdin, in the PSL First Aid Room, and in the office of the KRC Safety Specialist. Indexes are located there as well as all safety bulletin boards.

6. Prevention of Spills and Accidents

Emergency Procedures are posted throughout the KRC. Call the Dane County Emergency Service (911) in an emergency. The phone number for the University Hospital Poison Control Center is 9-262-3702. Provide First Aid according to the chemical's Material Safety Data Sheet or *First Aid Manual for Chemical Accidents*, located in the SRC First Aid Locker. An important first step in any corrosive chemical accident is to flood the affected area with large amounts of water.

At least two people are to be present when highly corrosive substances are used.

If a major spill occurs outside of a laboratory fumehood, evacuate the building; cleanup personnel must wear suitable protective apparel and equipment. Prepare for spills, read the MSDS, and handle spills appropriately.

Transport containers of corrosive chemicals in bottle carriers, which can be found in the SRC Chemical Storage Building and in the SRC Chemical Room.

7. Waste Disposal

Concentrated acids and bases are to be neutralized prior to disposal. Acid and base neutralizers are located in the SRC Chemical Room and in the PSL Vacuum Test Area. Instructions are on the containers. Neutralized chromic acid can NOT be poured down the drain. Ensure that the neutralizing agent is correct for the chemical. If hydrofluoric acid is to be neutralized, calcium hydroxide will work well. Seek assistance from the KRC Safety Specialist or Chapter 16 "*Laboratory Waste Disposal Program*" for acid or base disposal procedures.

Cylinders of corrosive and hazardous gases are to be sent to the UW Safety Department. Obtain assistance from the KRC Safety Specialist.

Chapter 23. Electrical Safety / Electrically Powered Laboratory Equipment

1. Policy

It is the policy of the KRC to take all reasonable precautions at the workplace to protect the health and safety of personnel and property. The electrical safety requirements in this chapter are those in addition to National Electrical Code. Federal, state and local electrical codes and laws are to be followed by all personnel.

2. Basic Guidelines

- Remove all metal jewelry, including rings and watches, prior to beginning any electrical work.
- Keep work area clean and orderly.
- Never work around a source of electricity when you, your surroundings, your clothing, or our tools are wet.
- Never remove the 3rd grounding prong from an electrical cord.
- Use insulated hand tools and double insulated power tools.
- Always inspect all electrical tools and extension cords prior to their use.
- Any frayed power or extension cord must be discarded.
- Always use ground fault circuit interrupters (GFCI) when working outdoors, near wet areas, and when using extension cords.
- When working near overhead power lines always maintain a minimum of 10 feet of clearance.
- Follow lockout/tagout procedures.

3. Responsibility

KRC Supervisors and Principal Investigators are responsible for all aspects of safety within their group.

Personnel are responsible for adhering to the applicable electrical codes, and ensuring their safety and coworkers' safety. Personnel will be trained to recognize the hazards in their work area, through training and supervision.

Personnel are responsible for

- Selecting and using the appropriate protective equipment.
- Learning and following appropriate procedures.
- Referring to supervisors for questions.
- Consulting the National Electrical Code, Wisconsin Administrative Code COM 16 "Electrical Code" or other reference texts.
- Referring to equipment manufacturer technical manuals.

4. Procedure

Task Identification (for installation, maintenance, and repair)

- Review the task
- Look for possible hazards
- Plan the work in an orderly fashion. Be prepared for emergencies.
- Resist schedule pressure. Do not bypass safe, careful procedures

Safe Design (during installation)

- Safety should be an integral part of any electrical work.
- Designs should include safety features such as guards, labels, interlocks, alarms, panic switches, fuses, breakers, etc.
- Ensure that the design incorporates a clear accessible path to all breaker panels and utilities.

Maintenance

- Maintain electrical equipment. Well-maintained equipment is safe equipment. If appropriate, keep a maintenance log for equipment.
- Follow the lock-out/tag-out procedure while performing maintenance or repairs.
- Maintain a clear zone in front of all breaker panels and utilities. Objects blocking access are subject to disposal.

Documentation

- Current documentation on operation, maintenance, and testing is to be available.
- Keep documentation current and maintain the latest version in file.

Reviews

- Have new designs or revisions reviewed by group members for safety considerations.

Testing

- Work on energized equipment ONLY when absolutely necessary.
- Do not work alone with energized equipment.
- Ensure that testing equipment is in safe working condition.
- Use the lock-out/tag-out procedure where applicable.

5. Specific Rules

Powered Equipment

- All power supplies, ion pumps, and hazardous electrical equipment are to have external grounding straps.
- Exposed connections on chambers are to be shrouded and protected from accidental physical contact.
- Alligator clips and banana plugs ARE NOT ALLOWED on hazardous electrical equipment.
- Apparatus untended for long periods of time should be equipped with fuses or other overload protection devices.

- Variacs are to be connected to ground-fault circuit interrupting (GFCI) circuit breakers or GFCI receptacles.
- Strain protection for ion gauge connectors and other cabling to vacuum electrical feedthroughs should be provided.

Other Equipment

- Mechanical vacuum pumps used at the SRC are to be exhausted into the SRC exhaust system.
- An oil mist filter is to be attached to the pump's exhaust before it enters the SRC exhaust system.
- Belt-driven mechanical pumps with exposed belts must have protective guards.
- Contaminated oil should be disposed prior to the next run.
- SRC turbomolecular pumps are to be used for initial evacuation of experimental chambers ONLY. They are not to be used to pump gas manifolds or for bakeouts.
- Never dry a volatile compound (i.e., organic compound) in a drying oven.
- Do not use a mercury thermometer in a drying oven. Bimetallic strip thermometers are the preferred alternative.
- Do not place uncapped or unlabeled containers of chemicals in the SRC or CNTech chemical refrigerators. Avoid placing explosive, highly toxic, or peroxide-generating chemicals in the refrigerator.

Grounding

- All electrical equipment must be grounded, according to accepted practices.
- Three-blade to two-blade grounding adapters are to be used only when absolutely necessary.
- The ground pin on plugs shall not be removed to accommodate two-blade receptacles under any circumstances.
- When using electrical equipment near water, in damp areas, or outdoors, use receptacles that are powered by GFCI circuit breakers or that are GFCI receptacles.

Extension Cords and Temporary Power

- Extension cords are to be used only for temporary power.
- All extension cords must have a grounding conductor.
- Power cords and heat tape are to be maintained in good condition. Frayed, patched, and cracked cords or tape will be disposed.
- Use an extension cord of adequate capacity.
- Extension cords are not to be run under carpeting or other flammable materials, in overhead spaces above ceilings, or suspended from ceilings.
- Tapered, self-sticking, rubber covers are available from the KRC Stockroom to place over cords laying on the floor where foot traffic may lead to tripping falls or damage.
- Do not "daisy-chain" electrical cords.

Interlocks on Electrical Equipment

- Interlocks should be designed into equipment where access into equipment by unauthorized personnel could cause personnel harm or where mechanical failure of equipment could cause further damage or dangerous conditions to personnel.

6. Lock-Out/Tag-Out Policy

Policy

To safeguard personnel while performing servicing or maintenance on machines and equipment where unexpected start-up or release of stored energy could cause injury. This includes: servicing and/or maintenance, constructing, installing, setting up, adjusting, inspecting, modifying, lubricating, cleaning and "unjamming". Exemptions: Cord and plug equipment. However, during maintenance, the equipment should be unplugged. This Lock-out/Tag-out policy covers electrical equipment as well as pressure and vacuum systems, water systems, and gas systems. This policy has been established to meet Wisconsin COM 32.50/OSHA 1910.147 "Control of Hazardous Energy".

Responsibilities

Supervisors are to ensure that all personnel working on hazardous equipment in their area of responsibilities are qualified for the level of work they are performing. All applicable safety training is to be received before personnel are qualified for the work being performed.

Personnel are responsible for complying with the lock-out/tag-out procedure when working. Personnel are responsible for complying with all established safe work practices for the task. For example, complying with the lock-out/tag-out policy and following confined space procedures when working in the SRC Mechanical Equipment Room water sump.

Lock-Out/Tag-Out Stations

Lock-out/tag-out stations are placed throughout KRC where energized equipment is located. Stations contain tags, padlocks, ball valve locks, gate valve locks, circuit breaker locks, and plug locks. Lock-out/tag-out equipment is also located in the First Aid Room of the PSL. Supplies may also be obtained through KRC maintenance personnel, KRC engineering staff, and Operations Group members of the SRC.

Procedures

- When the equipment will accommodate a lock-out, do so after de-energizing the equipment.
- The lock-out must be applied to the main power source supply power to the circuit or piece of equipment.
- If equipment cannot be locked-out, a "Danger" tag must be attached and properly filled out, after de-energizing the equipment.
- Lock-outs or tag-outs shall only be removed by the person(s) placing them on the equipment. No exceptions!! NEVER REMOVE ANOTHER PERSON'S LOCK OR TAG.
- At no time shall a locked-out or tagged-out piece of equipment be energized without the proper approval.
- Lock-out/tag-out materials for circuit breaker panels, gate valves, and ball valves are available from the KRC Safety Specialist, SRC Operations Group, SRC Engineering Group, KRC Maintenance staff, facility safety officers, and in the PSL First Aid Room. Lockout hasps, padlocks, and tags are also available.
- When working in confined spaces, ensure that all sources of energy within and affecting the confined space are locked out. Additionally, lock out all water service, pumps,

valves, and other sources of hazard affecting the confined space. Refer to Chapter 36, *"Confined Space Operations"*.

- Work on energized systems may only be conducted when permission has been obtained from the relevant group leader. A thorough review of the system and its hazards is to be completed prior to beginning work on the system.

Chapter 24. Material Handling, Overhead Cranes, Forklifts Fleet Vehicles, Tractors and Aerial Lifts

1. Overhead Cranes

Policy

KRC overhead cranes and operation of overhead cranes are subject to COM 32.50/OSHA 1910.179 and 1910.184, in addition to ANSI/ASME B30.16 "Hoists", B30.2 "Overhead and Gantry Cranes", B30.17 "Overhead and Gantry Cranes", B30.11 "Monorails and Underhung Cranes", and B30.9 "Slings".

The KRC Overhead Crane safety policy was established to limit personnel exposure to the hazards associated with overhead cranes, lifting loads, and moving suspended loads. Serious injuries or damage may result from overloading, dropping or slipping of the load, obstructing the passage of the load, and using equipment in a manner for which it was not designed.

Definitions

ANSI- American National Standards Institute

ASME- American Society of Mechanical Engineers

Braided wire rope- Rope secured at the hoist drum and ending with the crane hook, made from braiding small wire ropes.

Bridge- Part of crane consisting of a girder which carries the trolley.

Crane- A machine for lifting and lowering a load and moving it horizontally.

Designated- Selected or assigned by the employer as being qualified to perform specific duties.

Drum- Cylindrical member around which the wire rope is wound.

Fitting- Machined piece secured to load through which a lifting sling passes for hoisting.

Floor operated crane- A crane which is pendant controlled by an operator on the floor.

Hoist- Apparatus exerting a force for lifting or lowering.

Hook- Latching device at the end of the wire rope from the hoist, which is the only point of connection for lifting slings or devices.

Lifting devices- Devices which are not a permanent part of the hoist, such as hooks on buckets, magnets, grabs, and other devices used for ease of handling certain types of loads.

Lifting slings- Assembly which connects the load to the crane hook or lifting device. Endless sling and double eye slings may be found at KRC. Slings may be formed from synthetic webbing, metal chain, or wire rope.

Load- Total weight on the hook.

Overhead crane- A crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway.

Overload- Any load greater than the rated load.

Qualified person- Person who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve or resolve problems relating to said operation.

Rated capacity- Maximum working load permitted for a particular lifting sling.

Rated load- Maximum load for which a crane or hoist is designed and built by the manufacturer and shown on the equipment nameplate.

Runway- Assembly of rails, beams, and girders on which the crane travels.

Sheave- Grooved wheel in pulley block on which wire rope travels smoothly.

Sling- Assembly which connects the load to the crane.

Stop- Device to limit travel of a trolley or crane bridge.

Trolley- Unit which travels on the bridge rails and carries the hoisting mechanism.

Upper limit device- Device that limits upward travel of hook toward hoist.

Construction and Installation

Construction and installation of KRC overhead cranes will be in compliance with all ANSI/ASME Standards. Copies of applicable standards are located in the office of the KRC Safety Specialist.

Overhead cranes in use at KRC:

- top running bridge, single girder, underhung hoist floor operated
- bottom running bridge, single girder, underhung chain hoist
- top running bridge, multiple girder, top running hoist floor operated
- monorail, bottom hung, floor operated hoist

All top running bridge, multiple girder, top running hoist floor operated cranes at KRC:

- Will have runway stops to limit travel of the bridge.
- Will have securely anchored runway supports.
- Will have runways and supporting structures designed to withstand the loads and forces imposed by the crane.
- Will be examined and tested by qualified personnel if any modifications are made.
- Will have trolley stops to limit travel of the trolley.
- Will have push buttons on pendant controls that return to OFF when pressure is released by the crane operator.
- Will have runway conductors shielded from accidental contact.
- Will have an upper limit device to prevent lifting of sheave and hook into drum.
- Will have latchable hooks for hoisting.

All top running bridge, single girder, underhung hoist floor operated cranes at KRC:

- Will have runway stops to limit travel of the bridge.
- Will have securely anchored runway supports.
- Will have runways and supporting structures designed to withstand the loads and forces imposed by the crane.
- Will be examined and tested by qualified personnel if any modifications are made.
- Will have trolley stops to limit travel of the trolley.
- Will have push buttons on pendant controls that return to OFF when pressure is released by the crane operator.
- Will have runway conductors shielded from accidental contact.
- Will have an upper limit device to prevent lifting of sheave and hook into drum.
- Will have latchable hooks for hoisting.

All bottom running bridge, single girder, underhung chain hoists at KRC:

- Will have runway stops to limit travel of the bridge.
- Will have securely anchored runway supports.

- Will have runways and supporting structures designed to withstand the loads and forces imposed by the crane.
- Will be examined and tested by qualified personnel if any modifications are made.
- Will have latchable hooks for hoisting.

All monorail underhung chain hoists at KRC:

- Will have runway stops to limit travel of the bridge.
- Will have securely anchored runway supports.
- Will have runways and supporting structures designed to withstand the loads and forces imposed by the crane.
- Will be examined and tested by qualified personnel if any modifications are made.
- Will have latchable hooks for hoisting.

Inspection and Maintenance

Inspections are divided into two classifications, with intervals between inspections dependent upon degree of wear or abuse, and frequency of use. The two classifications are: frequent, which requires routine visual inspections by the crane operator or other designated personnel with no records kept; and periodic, which requires a biannual visual inspection by a designated person with detailed records. Periodic inspections will be performed by a qualified person, with all necessary repairs also performed by a qualified person.

Frequent inspections are to include:

- Observations during operation.
- Any conditions considered hazardous or in need of repair is to be noted to the appropriate Building Manager or KRC Safety Specialist.
- Inspection of operating mechanisms, upper limit device, hooks and hook latches, and hoists.
- Examination of wire rope for corrosion, breaks, wear, and kinking.
- Examination of slings for wear, damage, fraying, and kinking. Slings that are damaged or defective are to be removed from service immediately.
- Examination of fittings for cracking and wear.

Periodic inspections are to include:

- All visual inspections as required for a frequent inspection.
- Support members and framework examined for cracks, deformation or corrosion.
- Rivets and bolts examined for looseness.
- Bearings, wheels, bumpers, stops, brakes and other mechanical parts examined for wear.
- Examination of electrical systems.
- Detailed examination of the hoist, including the drum, sheave and wire rope.

Before using lifting equipment, slings and fittings are to be examined for damage or defect. Slings or fittings that are damaged or show defect are to be immediately removed from service. Burrs or sharp edges found on fittings are to be removed. Slings may not be repaired and returned to service. Once removed from service, slings are to be destroyed and disposed of in the trash.

Slings or fittings are to be removed from service if:

- The sling has acid or caustic burns.
- The sling has melting or charring of any part of its surface.
- The sling has snags, punctures, tears, or cuts.
- The sling has broken or worn stitches.
- The sling has excessive abrasive wear.
- The fitting has excessive pitting or corrosion.
- The fitting has cracked, distorted, or broken features.
- Any other visible damage that causes doubt of safety.
- The sling's tag is unreadable or otherwise damaged.

New, repaired, and modified overhead cranes are to be operationally tested by a qualified person prior to putting into service. Tests are to include lifting and lowering; trolley travel; bridge travel; hoist limit devices; and travel limit devices.

New, repaired, and modified overhead cranes should be load tested by a qualified person prior to putting into service. A written report will be placed on file with the Building Manager. When an overhead crane is modified, it should be examined relative to the current standard by a qualified person. If the crane differs substantially from the current standard, the need to meet the current standard is to be evaluated by a qualified person. Recommended changes are to be made within one year.

During any maintenance to an overhead crane, the KRC Lockout/Tagout Policy shall be complied with. See Chapter 23 *"Electrical Powered Laboratory Equipment"*. Any maintenance conducted at an elevation where potential for injury from a fall exists, shall comply with the KRC Fall Protection Policy. See Chapter 37 *"Fall Protection"*.

Necessary repairs indicated by frequent or periodic inspections should be completed as reasonably soon as possible. Repairs will be undertaken by a qualified person. Temporary repairs of sling webbing, threads, or fittings are not permitted.

A load may not be suspended from an overhead crane during maintenance. The load is to rest on the ground.

Training

The following persons are allowed to operate electrically powered overhead cranes at KRC:

- Qualified persons, having completed a crane safety class.
- Trainees in the crane safety class.
- Maintenance or inspection staff

Persons operating an electrically powered overhead crane are to receive training in the operation of overhead cranes. A demonstration of operational skills will be passed before persons are qualified to operate an KRC electrically powered overhead crane. Training will be provided by qualified personnel. Documentation of training received and a list of qualified crane operators will be maintained by the KRC Safety Specialist and the SRC Operations Group [for SRC qualified Users].

Non-powered cranes or simple chain hoists may be operated by any personnel who have received training specific to the hand powered crane or simple chain hoist. Personnel using non-powered cranes are to comply with rules for safe use of overhead cranes. No log of users will be maintained.

Operation

Electrically powered overhead cranes will only be operated by qualified persons.

Lifting operations require a minimum of two persons. A qualified person is to operate the crane control. An assistant should observe the area and load to ensure that there is no hazard to workers in the area.

Operators of overhead cranes are not to engage in any other activity which may distract them from the operation of the crane. If physically unfit [i.e. dizzy], the operator is to turn over control of the crane to another qualified person. The crane operator is in charge of each lift. Each operator is responsible for those operations under his charge during a lift. If there is any doubt as to safety of the lift, consult with a qualified person before beginning the lift.

The operator should be familiar with the crane and its operation prior to beginning work. If any repair is needed or defect known, the operator is to report them to the appropriate Building Manager or the KRC Safety Specialist.

Moving the bridge or the trolley toward its stop is to be done carefully to avoid damage to the bridge, trolley, or hoist, and loss of control over the suspended load.

The overhead crane and slings are not to lift a load in excess of their rated loads. A tag is stitched to each sling, listing load limits for three types of sling hitches (basket, vertical, and choker). The actual capacity of a sling is dependent upon the angle of the load to the sling. See chart posted by the slings. In practice, the smaller the angle, the lower the actual capacity. For example, a 5° angle causes a 8.7% lifting efficiency. This would result in a 87 pound actual lifting capacity for a 1000 pound vertical rated weight limit. The hoist wire rope is to be free of kinks or twists and is not to be wrapped around the load. The load is to be attached to the hook by means of slings. SRC slings, fittings, and secondary chain hoists are located in the Aladdin vault. PSL slings, wire rope, fittings, and other overhead crane materials are located in the machine shop high bay.

Lifting operations require at least two persons, including a qualified operator of the crane. The operator of the crane is to ensure that:

- The load, sling, fitting, or lifting device is seated in the bowl of the hook, and the latch is closed. The equipment is to be inspected prior to the lift.
- The load is secured, balanced, and positioned before the load is lifted more than a few inches.
- The hoist wire rope is not kinked.
- The lifting slings are not kinked, knotted, or twisted around other lifting slings. Knotted or twisted slings are not to be used.

- The slings are to be securely attached to the load, and the slings padded to protect the sling from any sharp edges of the load.
- The hook is centered over the load to minimize swinging.
- The wire rope is seated in the sheave if the rope has been slack.
- Personnel have vacated the area of the lift.

During lifting avoid sudden acceleration or deceleration of the moving load. Maintain care to avoid obstacles while moving the load. Overhead cranes are not to be used for side pulls. Shock loading is prohibited. Take up the slack in the slings slowly.

Overhead cranes shall, under no circumstances, be used to transport, lift, or lower person(s). Personnel shall not be involved in pranks or horseplay involving overhead cranes. Operators of cranes shall not transport loads over personnel. The area must be cleared before a load may be moved through.

The operator of the crane may not leave the immediate area of the pendant control while the load is suspended. When not in use, all loads should be placed on the floor and power to the control turned off.

The crane hook should be lifted above head level when not in use. Do not park the crane bridge directly beneath overhead lights.

Hands or fingers shall not be placed between the sling and the load while the sling is being tightened around the load.

Slings should be stored in a cool and dry location. Slings should not be dragged on the floor or over an abrasive surface. Please do not store slings on the floor. Equipment rolled or personnel walking over slings cause abrasion, wear, and may damage the slings.

2. Manual Material Handling

It is very important that personnel handle materials properly to prevent injuries. Musculoskeletal injuries happen frequently when heavy objects are lifted improperly.

Before moving the load, inspect it for sharp edges, slivers, and slippery spots. Wear work gloves when handling loads with sharp edges or that have slivers. Inspect the route the load will travel for obstructions, wet spots, or spills that could cause an accident. If the distance is long, use a cart. Determine if the load is too heavy for one person. If it is, arrange to work with others during the move.

To lift an object safely:

- Ensure that you have good footing and place your feet about shoulder width apart.
- Squat with your back straight. Use your legs to lift the object, not your back.

- Take a firm grip on the object and straighten your knees. If the object does not lift, have another person help you, or obtain a mechanical lifting device. Do not strain and potentially cause a musculoskeletal injury.
- If the lift is successful, carry the load close to your body.
- If you must turn while carrying the load, do not twist your torso. Turn your entire body. By moving your feet, your entire body will rotate.
- To set an object down, follow the above steps in reverse.

Use four-wheel carts or two-wheel carts when transporting heavy objects. Before using a cart, it should be inspected to ensure that it is capable of transporting the load. If the cart is damaged or shows a defect, the appropriate Building Manager or the KRC Safety Specialist should be notified and the cart removed from service. At SRC carts are located on the lower level. At PSL carts are located by the KRC Stockroom. When transporting a large gas cylinder, it is to be chained into a two-wheel cart. Only one gas cylinder may be transported on each trip with a cart.

When moving up a ramp, if heavily loaded or moving a gas cylinder, the cart should be pushed forward. When moving down a ramp, if heavily loaded or moving a gas cylinder, the cart should be eased down the ramp backward.

Never transport personnel on a cart.

If loads are to be transported by truck, secure the load to the truck to prevent shifting of load during transport. While loading, the truck wheels should be blocked to prevent movement.

When unloading a vehicle, if personnel are exposed to traffic, orange safety vests must be worn.

Back support belts, which provide an additional degree of safety, may be obtained from the SRC safety cabinet, PSL First Aid Room, or from the KRC Safety Specialist. A back support belt should assist and remind you to maintain a straight back while lifting an object.

3. Forklift Use

Policy

KRC forklift's construction, maintenance, operator training, and forklift use shall comply with OSHA 1910.178 and ANSI B56.1 "Powered Industrial Trucks". This policy was established to ensure forklift operators are adequately trained and KRC forklifts are safe to operate.

Definitions

Fork extension- Metal sleeve over existing fork blade which allows for a longer base for lifting or lowering loads.

Forklift- Type of powered industrial truck for transport of loads with two or more blades on the front for elevating or lowering loads.

Front end attachment- The two or more metal blades used for lifting or lowering a load.

Load- Total weight on the fork.

Mast- Vertical component of the fork.

Qualified person- Person who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve or resolve problems relating to said operation.

Rated load capacity- Maximum load for which a forklift is designed and built by the manufacturer and shown on the equipment nameplate.

Unattended- When the forklift operator is 25 feet or more away from the forklift, or whenever the operator leaves the vehicle and it is not in his view.

Training

Operators of the KRC forklifts must attend a certified forklift safety training class and pass a certification test before use. Training will be provided by a qualified forklift training consultant. Operators will be instructed in the characteristics of the forklift he/she will operate, common forklift hazards, and safe operation of the forklift. Operators will be retrained when new equipment is introduced, existing equipment is modified, or when an operator's performance is unsafe.

Construction, Inspection and Maintenance

The KRC has two Class LP forklifts. Class LP indicates that the forklift is powered by liquefied petroleum gas, and meets minimum acceptable safeguards against inherent fire hazards. Class LP forklifts are not to be used in atmospheres containing hazardous concentrations of flammable chemicals, metal dusts, or ignitable materials.

Forklifts in use at KRC are to have an overhead guard.

Modifications or additions that could affect safe operation or load capacity are not to be performed by the KRC or forklift operator without manufacturer's prior written approval. Capacity, operation, and maintenance instruction plates, tags, or decals will be changed accordingly.

All nameplates and markings are to remain in place and be maintained in a legible condition.

All forklifts used at KRC, must meet ANSI B56.1 requirements. A label affixed to the forklift will indicate that it meets ANSI requirements.

The forklift will be marked identifying the front end attachments, and showing the approximate weight of the forklift and attachment combination and the capacity of the forklift and attachment combination at maximum elevation.

All KRC forklifts must have a horn and a yellow light, which flashes when the engine is operating. A fire extinguisher is to be installed near the forklift controls.

Any forklift not in safe operating condition is to immediately be removed from service. The forklift is not to return to service until it has been returned to safe operating condition. If repairs were conducted to the fork blades, test loading at 2.5 times the rated capacity of the fork is to be performed prior to return to service.

No forklift is to be operated with a leak in the fuel system until the leak has been corrected. Do not check electrolyte level in the battery with an open flame. Repairs are not to be conducted in areas of flammable chemical storage.

KRC forklifts will be inspected periodically and maintained by trained and qualified personnel.

Operation

The operation of KRC forklifts is to be in compliance with OSHA 1910.178 and ANSI B56.1-1993. It is the responsibility of the operator to use the forklift safely.

The forklift is to be examined prior to use. Examine the tires, warning or safety devices, battery, controls, fuel system, brakes, steering, and lift and tilt systems. If the inspection shows any condition adversely affecting the safe operation of the forklift, it is to immediately be removed from service.

If the forklift is equipped with an operator restraint system, operators shall use the restraint system.

When unloading a vehicle, if personnel are exposed to traffic, orange safety vests must be worn. Safety vests are located on each forklift.

Additional counterweighting of forklifts will not be done unless approved by the forklift manufacturer.

Forklifts shall not be driven up to a person standing in front of a fixed object. No person shall be allowed to stand or pass beneath an elevated load or raised fork. Passengers are not allowed on KRC forklifts. Forklifts shall not be used to elevate personnel. Arms and legs are to remain within the cab of the forklift.

All traffic regulations are to be observed, including the posted 10 mph speed limit on the KRC grounds. Safe distances are to be maintained between forklifts and other vehicles, including other forklifts, and the forklifts are to be kept under control at all times. The right of way is to be yielded to any pedestrian or emergency vehicle. Forklifts are not to pass another moving vehicle, under any circumstance. The driver of the forklift shall sound the horn at all interior and exterior intersections and other locations where vision is obstructed. If the load obstructs forward vision, the driver must travel in reverse. Driving up or down grades is to be done slowly. Avoid turning while on a grade.

In all weather conditions, the forklift is to be operated at a reasonable speed which would allow braking to stop in a safe manner. Stunt driving and horseplay is not allowed. Forklifts are to be driven slowly over wet or slippery surfaces. Do not drive over road debris. When making a turn, speed is to be reduced to a safe level. Symptoms of excessive speed are tire skidding, forklift sway, wheel lift, and the need to grip the steering wheel tightly to avoid from sliding out of the operator's seat.

Ensure the load is stable on the fork before transport. Pay particular attention to off-center loads. Do not attempt to transport a load in excess of the rated load capacity of the forklift. The mast should be tilted backwards to stabilize the load for transport. The fork lift blades should be at least two-thirds the length of the load. Care should be used when tilting loads forward or

backward. An elevated load should not be tilted forward except when in position to deposit the load on a stack. When transporting the load, make turns slowly and smoothly to avoid shifting the load and overturning the forklift.

If the forklift does tip over, the operator should stay with the forklift. The operator should hold on firmly and lean away from the point of impact.

When driving onto a truck or trailer bed, the brakes of the truck or trailer must be applied and chocks shall be used to prevent unintentional movement.

When leaving the operator's seat, the forklift is to be brought to a complete stop, controls put into neutral, apply the parking brake, and lower the load and/or fork blades to the ground. If leaving the area, the power to the forklift is to be turned off.

Extra care should be taken when using fork extensions. Inspect fork extensions prior to each use. Examine for bending, corrosion, cracking or any other defect which would affect its safe use. Fork extensions exhibiting any defect are to immediately be removed from service. Fork extensions are to only be obtained through a qualified forklift supplier. Extensions are to be repaired or constructed only by trained and qualified personnel.

4. Fleet Vehicle Use

Fleet cars may be used by any qualified personnel holding a valid driver's license. A "Vehicle Use Agreement" form is to be completed and submitted to UW Risk Management for approval. Forms are available in the PSL Accounting Office. The state-wide *Fleet Policies and Procedures Booklet* is to be read before operation of any fleet vehicle.

Fleet vans may only be used by personnel meeting the above requirement in addition to attending a fleet van safety training class. Fleet trucks may only be used by qualified personnel.

All traffic regulations are to be observed, including the posted 10 mph speed limit on the KRC grounds. Safe distances are to be maintained between a fleet vehicle and other vehicles, and the fleet vehicle is to be kept under control at all times. The right of way is to be yielded to any pedestrian or emergency vehicle. Fleet vehicles are not to pass another moving vehicle, while on the KRC grounds, under any circumstance. In all weather conditions, the fleet vehicle is to be operated at a reasonable speed which would allow braking to stop in a safe manner. Stunt driving and horseplay is not allowed. Fleet vehicles are to be driven slowly over wet or slippery surfaces. Do not drive over road debris.

5. Tractor Use

Qualified custodial staff may use tractors for mowing the KRC lawn and for plowing the snow from sidewalks and parking lots.

When operating a tractor while mowing the lawn or plowing snow, if personnel are exposed to traffic, orange safety vests must be worn. Safety vests are located with each KRC forklift.

All traffic regulations are to be observed, including the posted 10 mph speed limit on the KRC grounds. Safe distances are to be maintained between a tractor and other vehicles, and the tractor is to be kept under control at all times. The right of way is to be yielded to any pedestrian or emergency vehicle. Tractors are not to pass another moving vehicle, while on the KRC grounds, under any circumstance. In all weather conditions, the tractor is to be operated at a reasonable speed which would allow braking to stop in a safe manner. Stunt driving and horseplay is not allowed. Tractors are to be driven slowly over wet or slippery surfaces. Do not drive over road debris.

6. Aerial Lifts

Policy

KRC aerial lift construction, maintenance, operator training, and use shall comply with ANSI A92.3-1990 “Manually Propelled Elevating Aerial Platforms”. This policy was established to ensure aerial lift operators are adequately trained and KRC aerial lifts are safe to operate. The KRC possesses a manually propelled aerial lift. Powered aerial lifts must comply with OSHA 1910.67 and ANSI A92.2-1969 “Vehicle Mounted Elevating and Rotating Work Platforms”.

Definitions

Aerial lift-Powered or manual device with telescoping or articulating sections used to position personnel at an elevation.

Platform-Personnel carrying device (basket or bucket) which is a component of an aerial lift.

Restraint system-A system including but not limited to an anchor point, connectors, and a body harness used to restrain a worker from falling from an aerial lift personnel bucket.

Training

Training will be provided by a qualified aerial lift trainer. Operators will be instructed in the characteristics of the aerial lift he/she will operate, common aerial lift hazards, and safe operation of the aerial lift. Operators will also be trained in fall protection and be instructed in the use of restraint equipment. Operators will be retrained when new equipment is introduced, existing equipment is modified, or when an operator’s performance is unsafe.

Construction, Maintenance and Inspection

All design and construction will conform to ANSI A92.3-1990 “Manually Propelled Elevating Aerial Platforms”.

Qualified personnel will inspect the aerial lifts annually. Repairs and maintenance will be conducted by qualified personnel.

Lift controls are to be tested before each use to determine that the controls are in safe working condition. Ensure outriggers extend properly.

Operation

Only trained personnel may operate an aerial lift. Inspect the aerial lift before using. Operate the controls to ensure proper function. Ensure brakes are set and outriggers are positioned on a solid surface. Do not exceed the aerial lift and platform load limits. The aerial lift may not be moved while personnel are on or in the platform or while the lift is elevated. Do not lean a

ladder or any other object against a aerial lift. Ensure the aerial lift and the personnel using the lift are clear of overhead wires and obstructions.

Personnel shall not sit or climb on the edge of the basket or place planks, ladders, or other devices on the platform to change the designed work position. A restraint system must be used when working from an aerial lift. The lanyard must be connected from the body harness to the boom or basket when working.

Chapter 25. Fires and Explosions

1. Policy

To ensure the safety of personnel and property at KRC from fires or explosions. The KRC complies with applicable fire prevention ordinances, COM 32 "Public Employee Safety and Health", and applicable National Fire Protection Association (NFPA) standards.

2. Fire Extinguishers

Fire extinguishers are to be used by KRC personnel or Users only against small, manageable fires. Halon, carbon dioxide and dry chemical fire extinguishers are located throughout the KRC facility. "Class D" Metal Fire Only fire extinguishers are located in the Aladdin vault and in the PSL Machine Shop. "Class ABC" Halon fire extinguishers are located in the SRC Aladdin vault and other sensitive locations. "Class ABC" dry chemical fire extinguishers are distributed throughout the KRC complex excluding sensitive locations. "Class BC" carbon dioxide fire extinguishers are distributed throughout the KRC.

Fire extinguisher training will be obtained through the UW Safety Department. The KRC Safety Specialist will arrange the time and location annually.

Keep areas around fire extinguishers clear. Red/white floor tape may be used to indicate fire extinguisher storage space. Signs fixed to walls or projecting from walls will be placed directly above fire extinguishers.

Fire extinguishers are classed according to the type of fire they can successfully extinguish.

Class A	Wood and paper
Class B	Flammable liquids
Class C	Electrical
Class D	Metal

The Halon and dry chemical fire extinguishers at the KRC are all ABC rated. The carbon dioxide fire extinguishers are Class BC rated. The classification of each fire extinguisher is imprinted upon the side of the fire extinguisher, as well as being printed on the label attached to the safety pin.

3. Fire Alarms

Fire alarms are located next to all exits from each facility.

Each building's fire alarm system automatically contacts the emergency dispatcher at the UW Department of Police and Security. The dispatcher sends to KRC a Campus Police Officer and contacts 911, which sends the Stoughton Fire Department and Dane County Sheriff's Department.

Upon hearing the fire alarm, a loud bell (SRC and CNTech) or loud horn (PSL and Gas Target), all persons shall evacuate the building and assemble at the PSL parking lot. All persons shall evacuate, unless a testing of the fire alarm system is announced. The person setting off the alarm should call the UW Department of Police and Security (9-262-2957), if possible, and verify the emergency.

4. Fire Drills

Fire drills are to be performed at least once per year. KRC personnel and Users are to participate, with NO exceptions. Prior warning will be provided, giving KRC Staff and Users time to protect equipment during the drill. All personnel shall evacuate, as in a real fire, to the designated assembly area.

Fire alarms are to be tested once per month.

5. Emergency Procedures

In case of an emergency, call the Dane County Emergency Service, 911.

- Anyone who sees a fire or who detects a fire hazard that may suddenly develop into an actual fire should immediately turn in a fire alarm (Fire alarm pull stations are located at all exits of each building, including the lobby).
- When a building fire alarm sounds, all persons shall leave the building. If possible, make a "head count" at the assembly point (PSL parking lot). The person reporting the fire should ensure that all persons keep out of the area until the Stoughton Fire Department arrives and assumes command.
- Upon hearing the alarm (loud bell or horn), the Operator on Duty [SRC] or other KRC supervisory staff should announce on the paging system, "evacuate building. There is an emergency".
- Call the UW Department of Police and Security, if possible, to verify the emergency. Give specific and accurate details to them. If possible, normal electrical power to the area should be turned off.
- Fire fighting action should be taken ONLY if this can be done with reasonable safety. Use "Class D" fire extinguishers for metal fires only. Use the appropriate fire extinguisher for the type of fire.
- Assist the Stoughton Fire Department if requested to do so. Do not reenter the building until the Stoughton Fire Department declares the area safe to enter.

6. Oxidizing Agents

Oxidizing agents are to be separated from flammable gases and chemicals. Storage of oxidizing materials (including oxygen) is to be with the nonflammable chemicals on the main floor of the SRC Chemical Storage Building or in the nonflammable chemical storage areas of PSL.

Chapter 26. Pressurized and Vacuum Operations

1. Vacuum Operations

All glass windows in vacuum systems are to be mechanically protected whenever they are not directly used.

Adequate strain protection for ion gauge connectors and other cabling to vacuum electrical feedthroughs is to be provided.

If any SRC vacuum accident occurs, inform the Operator on Duty, the person in charge of your research program and the beamline manager immediately.

Mechanical vacuum pumps used at the SRC, are to be vented into SRC's exhaust system. An oil mist filter is to be attached to the pump's exhaust before it enters the SRC exhaust system. If solvents, hazardous or corrosive substances are inadvertently drawn into the pump, the oil is to be changed before further use.

In order to avoid exploding windows, chambers should be vented with a relief valve set to less than 0.5 psi.

Glass enclosed ion gauges are not permitted.

Any chamber at SRC that uses a turbomolecular pump for maintenance or operates at a higher pressure than the beamline, is required to have an interlocked valve between the chamber and the beamline. The interlock must meet at least the three following conditions:

- It must close the valve when there is a power failure.
- It must close the valve if the turbo pump trips off.
- It must close the valve if the pressure downstream from the valve (user's side) exceeds the pressure upstream from the valve(storage ring side).

2. Cryogenic Liquids

Eye protection, including a face shield, must be worn when handling cryogenic fluids. Gloves, which are impervious to cryogenic fluids and loose enough to toss off easily must be worn.

The transfer of liquefied gases should not be attempted for the first time without the direct supervision and instruction by someone experienced in this operation. See the SRC Operator on Duty or your supervisor for assistance.

3. Pressurized Gas Cylinders

Storage

- Long-term storage of small gas cylinders for use at SRC is to be in the SRC Chemical Storage Building. Nonflammable gases and oxidizers are stored on the first floor, while flammable gases are stored on the second floor of the SRC Chemical Storage Building. Small gas cylinders are to be stored in the provided storage bins. Large gas cylinders are

to be chained to the wall or chained in storage racks. Gas cylinders may not be stored in the vault.

- At SRC, large gas cylinders are stored outside the Machine Shop. There are separate racks for empty and full cylinders. Do not mix flammable and nonflammable gas cylinders. Ensure that the cylinders are chained into the storage rack.
- At PSL, large gas cylinders are stored near the Vacuum Test Area. There are separate racks for empty and full cylinders. Do not mix flammable and nonflammable gas cylinders. Ensure that the cylinders are chained into the storage rack.
- At CNTech, large gas cylinders are stored in the Compressor Building. Ensure that the cylinders are chained into the storage rack.
- The KRC Safety Specialist is to be notified of incoming gas cylinders and provided Material Safety Data Sheets prior to their arrival.

Usage

- All hazardous gases used at the SRC must be contained in a gas cabinet that is exhausted into the SRC exhaust system. Use dosing cylinders with leak valves if possible when using very hazardous gases. Submission of a gas handling diagram is required prior to utilization.
- Ensure that the gas system's lines have been purged before disconnecting the gas cylinder.
- All components involved in gas handling are to be mechanically secured.
- Any valves used in the lines are to be rated to handle whatever pressures might be expected during their use.
- All gas cylinders are to have identification stamped or tagged to the cylinder.
- Cylinders containing flammable gases and mixtures are to be properly grounded.
- Regulators and valves for oxidizing gases and mixtures are to be free of any petroleum based oils, greases, or lubricants.

Waste Disposal

- Empty cylinders should be given to the KRC Safety Specialist for disposal.
- Contact the KRC Safety Specialist with any questions concerning unwanted gas cylinders.

Transport

- Lecture bottle cylinders may be transported by hand. Large gas cylinders are to be chained securely to a two-wheel hand cart and transported carefully.

4. Laboratory Pressure Vessels

All laboratory pressure vessels are to be tested and inspected periodically. The interval between tests or inspections is determined by the severity of the work involved. Inspection data should be placed on an attached label. Data should include the allowable working pressure, the allowable temperature at this pressure, and the material of construction.

Similarly, the relieving pressure and setting data should be attached to pressure-relieving devices.

See pages 79-81 of *Procedures for Working with Chemicals in Laboratories* for further safety procedures. (Available from the KRC Safety Specialist)

Chapter 27. Evacuation of SRC Vault Prior to Injection

1. Procedure

Prior to injection, the Operator on Duty announces that injection will occur in approximately ten minutes. SRC personnel and Users should begin to leave the vault when the announcement is made. The evacuation procedure follows. The northeast vault door is closed. The air handling room, microtron vault, and power room are cleared. The first cycle of sirens begins. After the center of the ring is cleared, the final stile gate is closed. The second cycle of sirens begins. The operators then sweep any remaining staff or Users from the CNTech Beamline Cleanroom and Aladdin vault. The last station checked is the CNTech Process Cleanroom. The overhead lights are turned off prior to the closing of the southeast vault door. After all personnel have exited the vault, and the final vault door is closed, a third cycle of sirens begins. Once the final vault door is closed, the injection process may begin.

Individuals who remain in the vault should either depress the red EMERGENCY STOP button or trip the interlock system. Doing this will prevent an injection. The red EMERGENCY STOP buttons are located outside of the ring, along the vault walls beneath the wall lights. These lights are turned on prior to closing the final vault door. The interlock system consists of a series of relays including the microtron vault, gates across the ring stiles, entrances to the vault and entrances to the CNTech cleanrooms. Breaking the relay contact will prevent an injection. The EMERGENCY STOP button is only effective during the injection process. Depressing the button other than during the injection process has no effect on the ring.

Chapter 28. Emergency Weather Procedures

1. Tornadoes

A "Tornado Watch" means weather conditions are favorable for the development of tornadoes in the area. Information on a "Tornado Watch" is given over radio and TV from the Weather Bureau or by emergency governmental agencies of the city and county.

A "Tornado Warning" means a tornado has actually been sighted in the area. The emergency sirens will sound a steady tone for three minutes or longer if there is any danger in the immediate area.

To report a tornado sighting, call the Dane County Emergency Service (911).

When warning sirens sound, an SRC Operator or KRC supervisor will announce over the PA system, "tornado warning. Seek the nearest tornado shelter". The Experiment Prep Area of the lower level of the Aladdin building, and the east hallway in the PSL High Bay Lab Area are the two designated tornado shelters at the Kegonsa Research Campus.

Immediately, upon hearing the announcement, report to the nearest tornado shelter. Stay away from outside walls and glass windows or partitions. While sheltered, keep listening to the radio for the latest tornado advisory information. Remain sheltered until the "All Clear" signal has been given over the radio. There is a weather radio in the Aladdin Experiment Prep Area and in the PSL vending machine area.

2. Thunderstorms

During power outages, emergency backup lights will come on-line throughout the facility. The batteries for the backup lights have approximately 2 hours of charge.

Chapter 29. Machine Shop, Hand Tools, Portable Power Tools, Welding, and Soldering

(Revised 8/2008)

1. POLICY

This section describes the policies of the KRC machine shops, use of portable power tools and hand tools, welding, and soldering at the KRC. Emphasis will be put on the personal safety of all personnel. KRC hand and portable power tools, maintenance of KRC hand and portable power tools, and operation of KRC hand and portable power tools must be in compliance with 29 CFR 1910 Subpart O “Machinery and Machine Guarding”, and Subpart P “Hand and Portable Power Tools and Other Hand Held Equipment”. In addition, all machine shop operations including the operation and maintenance of welding and cutting equipment shall conform to applicable provisions of 29 CFR 1910 Subpart Q “Welding, Cutting and Brazing” and the American National Standards(ANSI). Applicable rules also must be complied with while performing soldering operations in areas of the KRC.

Prior to using any machine tool, hand tool, portable power tool, welding or soldering equipment read and comply with all operating instructions and safety warnings provided by the manufacturer.

SRC MACHINE SHOP

The SRC Machine Shop is located on the lower level of the Aladdin Building. SRC Machine Shop personnel fabricate Aladdin ring and beamline components, and perform work for Users. Machine shop personnel operate under the supervision of the Engineering Group Leader. Proper machine shop operations are to be followed in addition to those mentioned below.

SRC staff and Users may use machine shop machine tools and other equipment with the below listed exceptions. A User workbench located in the machine shop is to be used by non-machine shop personnel while working in the machine shop. All persons using power tools, machinery or welding equipment in the machine shop are to first be checked out by regular SRC Machine Shop personnel.

There are six pieces of SRC shop equipment that are off limits to all but SRC Machine Shop personnel. These are as follows:

- Mitsui surface grinder
- Rockwell hardness tester
- Bridgeport vertical mill
- Miller TIG welder
- Hardinge tool room lathe
- Republic lathe

No personnel are to work alone in the SRC Machine Shop prior to 8am or after 6pm during a normal work week or at any time during the weekend.

PSL MACHINE SHOP AND SUPPORT SHOP

The PSL Machine Shop is located in the southwest portion of the PSL. PSL Machine Shop personnel fabricate parts for researchers and research facilities. Machine shop personnel operate under the supervision of the PSL Machine Shop Supervisor. Proper machine shop operations are to be followed in addition to those mentioned below.

PSL non-machine shop staff and Users may only use machine tools and other equipment in the PSL Support Shop. All persons using power tools or machinery in the Support Shop are to first be checked out by regular PSL Machine Shop personnel.

The PSL Support Shop may not be used outside normal working hours without permission from the PSL Machine Shop Supervisor.

2. GENERAL SHOP RULES

Safety glasses shall be worn for all machine operations and when flying object hazards exist. Safety glasses may be found on shop benches or in the red or yellow safety glasses bins at shop entrances. Face shields are to be used for all grinding operations including belt-sanders, hand-held grinders or sanders.

Loose clothing, neckties or gloves will not be permitted around any machine tool or portable power tool. Long hair is to be bound and tucked into the shirt. Rings, loose bracelets, and necklaces are not to be worn around any machine tool or portable power tool.

Do not rush through your work. Pay full attention to the job that you are doing. Be prepared to immediately shut down the machine tool.

Sandals are not allowed in any shop area. Protective footwear is required at all times for all shop personnel. KRC employees are provided with a yearly safety shoe allowance. KRC requires that personnel using a KRC Machine Shop or who are working with heavy objects wear protective footwear. Toe guards are available in the SRC Machine Shop for those without steel toed boots.

First aid equipment is available in the SRC Machine Shop, in the SRC Experiment Prep Area, PSL First Aid Room, PSL Machine Shop Emergency Equipment Locker, and first aid kits are located throughout the KRC complex.

Hearing protection must be worn in areas where noise levels equal or exceed 90 decibels for a forty hour work week. Hearing protection is recommended when noise levels equal or exceed an 85 dBA TWA. These areas will be posted. It is recommended that personnel wear hearing protection whenever power drills, saws, arc welders, or any other equipment which produce loud noise are used. Ear plugs and ear muffs are located in the SRC Machine Shop, SRC Safety cabinet, PSL Machine Shop, and PSL Stockroom.

Before starting a job, be sure that all equipment is in safe operating condition. All machine guards must be in place prior to operation. Any equipment, including portable tools, that is damaged or in need of repair to safely operate is to be removed from service. Only qualified personnel may repair equipment.

Compressed air is not to be used for cleaning except where reduced to less than 30psi and then only while wearing appropriate eye protection.

Push blocks must be used when cutting small pieces with nonportable power saws.

Adequate clearance is to be maintained between machines so that movement of one operator will not interfere with the work of another. Space for cleaning machines, handling material, work pieces, and scrap is also to be maintained. Machine shop floors are to be kept in good condition and free from obstructions, grease, oil, and water.

All machine tools and portable power tools must be guarded at exposed points of operation, blades, rotating parts, and any operating points that send off flying chips or sparks. Only necessary exposure of blades, rotating parts, or other operating points for safe operation of the machine tool and portable power tool should be allowed.

Machine guards shall not be removed or modified without prior approval from the shop supervisor. Machine guards for power saws, abrasive wheels, mills, and belt sanders or any other power equipment shall be in compliance with 29 CFR 1910.212 and 1910.213

All machines are to have a mechanical or electrical power control to make it possible for the operator to cut off the power without leaving his operating position. Avoid leaving a machine tool while it is operating or in motion, even if it is coasting with power off.

When replacing a band saw blade, sanding belt, abrasive wheel, or any other piece of equipment of a machine tool, ensure that the tool will not be capable of re-energizing during the work. In all cases, follow proper Lock-out/Tag-out procedures as outlined in Chapter 23 "*Electrically Powered Laboratory Equipment*". Lock-out/Tag-out supplies, if not available in the Machine Shop, may be obtained from any of the Lock-out/Tag-out Stations, from SRC Operations, SRC Engineering or KRC Maintenance staff, from the PSL First Aid Room, or from the KRC Safety Specialist.

All broken or damaged machine shop tools are to be returned to the machine shop for repair or replacement (this includes broken or dull taps and drill bits).

Return all excess metal stock and machine shop tools and equipment to their proper storage area after use.

Each person is responsible for cleaning up his or her mess (chips, scrap, grindings, and general clutter). Place dirty rags or waste material in the proper container after use. Clean the machine tool or piece of equipment when finished with the equipment.

The machine shops have a great variety of measuring tools, both English and Metric, that may be used by qualified personnel. Any tools or measuring devices removed from the shop area are to be signed out on the sheets provided on the tool cabinets.

There is a small drafting area in the SRC Machine Shop office that may be used. No drafting instruments may be removed from the office area. There is a large granite surface plate that is available for precision measuring and layout in the SRC Machine Shop. Care must be taken not to drop heavy objects on this plate. No pounding or hammering on the granite surface plate is permitted.

At PSL, no machine tools may be used by non-PSL Machine Shop personnel other than the machine tools in the shop reserved for User work. This area is located near the PSL vending machine area.

Manuals for welding and machining, as well as recommendations for procedure or design may be obtained through KRC machine shop personnel.

3. HAND TOOLS AND PORTABLE POWER TOOLS

Portable power tools and hand tools are only to be used for their designed purpose. For example, do not use a screwdriver as a chisel, or a power drill for widening a hole.

All persons using power tools are to seek training from a qualified person prior to first use.

Safety glasses shall be worn for all operations where flying object hazards exist. Safety glasses may be found on machine shop benches, in the red or yellow safety glasses bin at shop entrances, or in any of the KRC portable tool carts. Face shields are to be used for all grinding operations including belt-sanders and hand-held grinders or sanders.

Loose clothing, neckties or gloves will not be permitted around any machine tool or portable power tool. Long hair is to be bound and tucked into the shirt. Rings, loose bracelets, and necklaces are not to be worn around any machine tool or portable power tool.

Sandals are not allowed while using a power tool or any tool that could cause a foot injury. Protective footwear is required at all times for all personnel who as a part of their duties are exposed to hazards which could cause a foot injury. KRC employees are provided with a yearly safety shoe allowance. Toe guards are available in the SRC Machine Shop for those without steel toed boots.

First aid equipment is available in the SRC Machine Shop, in the SRC Experiment Prep Area, PSL First Aid Room, PSL Machine Shop Emergency Equipment Locker, and first aid kits are located throughout the KRC complex.

Hearing protection must be worn in areas where noise levels equal or exceed 90 decibels for a forty hour work week. Hearing protection is recommended when noise levels equal or exceed an 85 dBA TWA. These areas will be posted. It is recommended that personnel wear hearing

protection whenever power drills, saws, arc welders, or any other equipment which produce loud noise are used. Ear plugs and ear muffs are located in the SRC Machine Shop, SRC Safety cabinet, PSL Machine Shop, and PSL Stockroom.

Before starting a job, be sure that all equipment is in safe operating condition. Any portable tool that is damaged or in need of repair to safely operate is to be removed from service. Only qualified personnel may repair equipment.

Compressed air is not to be used for cleaning except where reduced to less than 30psi and then only while wearing appropriate eye protection.

All machine tools and portable power tools must be guarded at exposed points of operation, blades, rotating parts, and any operating points that send off flying chips or sparks. Only necessary exposure of blades, rotating parts, or other operating points for safe operation of the machine tool and portable power tool should be allowed.

Portable power tool guards shall not be removed or modified without prior approval from the shop supervisor. Machine guards for power saws, abrasive wheels, mills, and belt sanders or any other portable power tool shall be in compliance with 29 CFR 1910.212 and 1910.213

Avoid leaving a portable power tool while it is operating or in motion, even if it is coasting with power off.

When replacing a saw blade, sanding belt, abrasive wheel, or any other piece of equipment of a portable power tool, ensure that the tool will not be capable of re-energizing during the work. The simplest means of doing so with portable power tools is to unplug the tool, place the plug in a lock-out device, tag the plug, or position the plug so you may observe its location at all times. In all cases, follow proper Lock-out/Tag-out procedures as outlined in Chapter 23 "*Electrically Powered Laboratory Equipment*". Lock-out/Tag-out supplies, if not available in the Machine Shop, may be obtained from any of the Lock-out/Tag-out Stations, from SRC Operations, SRC Engineering or KRC Maintenance staff, from the PSL First Aid Room, or from the KRC Safety Specialist.

All broken or damaged machine shop tools are to be returned to the machine shop for repair or replacement (this includes broken or dull taps and drill bits).

Return all metal stock, tools and equipment to their proper storage area after use.

Each person is responsible for cleaning up his or her mess (chips, scrap, grindings, and general clutter). Place dirty rags or waste material in the proper container after use. Clean the portable power tool or piece of equipment when finished with the equipment.

4. GENERAL WELDING SAFETY POLICY

Welding operations may be conducted in the SRC Machine Shop with the permission of the Machine Shop supervisor or SRC Engineering Group Leader. A welding work station has been

set-up in the SRC Machine Shop. PSL has established a welding shop in the PSL Machine Shop. Welding may occur in other areas of the PSL, with the approval of the PSL shop supervisor. Only qualified KRC personnel may operate welding equipment.

Hazards posed to welders include exposure to metal fumes, welding gases, and radiation. Metal fumes are generated when the metal being welded becomes molten. Metal vapor is formed at temperatures above those where metal becomes molten. As the metal vapor cools, it condenses to very small spherical metal particulates called fumes. These metal fumes are small enough to enter the body through inhalation into the lungs and absorption into the bloodstream from the lungs. "Metal fume fever" is the result of short term exposure to high concentrations of metal fumes. Symptoms are similar to the flu, and "metal fume fever" generally passes within 24 hours. Some materials, for example chromium or cadmium, when exposed chronically may cause serious health problems. Silicon dioxide is used in the coating of some welding rods. During welding large concentration of free silica may be generated. Free silica, crystalline silicon dioxide, can lead to silicosis, a lung disease. Hazardous gases may be formed during the welding process. Nitrogen dioxide or ozone may be created while arc welding. Both are irritant gases, however toxic exposures may occur. Phosgene may be created when ultraviolet light interacts with chlorinated hydrocarbons. Phosgene is a very corrosive gas, which reacts with moisture in the lungs to form hydrogen chloride, causing great destruction of lung tissue. The gases used for gas shielded welding may displace oxygen in the room atmosphere. This may cause asphyxiation. The ultraviolet light created by the arc, in addition to causing the creation of ozone and phosgene, may cause skin burns if skin is exposed to the UV light. UV exposure may also cause "welder's flash", which is an excessive exposure to UV upon the eye's lens. It feels similar to sand in one's eye. Infrared light may cause heating of the skin and possible thermal burns. Intense visible light generated by the arc in arc welding may cause damage to the retina of the eye.

In any operation where there is possible exposure to injurious light rays or radiant energy, eye protection with the proper filter lenses must be used. Filter lenses should be of a shade number suitable to the type of work being performed. Different types of welding require different filters. Ensure that the filter/eye protection you are using is appropriate for the type of welding you are doing. All persons in the immediate area of welding must either be screened from exposure to hazardous light or be wearing eye protection with the proper filter lens.

Personal protective equipment applicable to the type of welding or brazing shall be worn. Protective gloves must be worn. Helmets designed to protect the face, neck, and ears from direct radiant light shall be worn during arc welding operations. Long sleeved shirts should be worn to protect against skin burns. Boots should be worn to protect against sparks and other hot materials.

Hearing protection must be worn in areas where noise levels equal or exceed 90 decibels for a forty hour work week. Hearing protection is recommended when noise levels equal or exceed an 85 dBA TWA. These areas will be posted. It is recommended that personnel wear hearing protection whenever power drills, saws, arc welders, or any other equipment which produce loud noise are used. Ear plugs and ear muffs are located in the SRC Machine Shop, SRC Safety cabinet, PSL Machine Shop, and PSL Stockroom.

Fluxes containing fluoride compounds should be prevented from contacting the skin or eyes. Fluoride compounds are used in the coatings of some fluxes. Exposure to fluoride compounds may result in eye, nose, throat or skin irritation, and chronic exposure may cause pulmonary edema or bone damage. If contact occurs, immediately flush with water and seek emergency care.

Welding or brazing fillers, fluxes and coatings may produce fumes or gases that are hazardous to health. Welding or brazing materials that contain cadmium or fluorine compounds will have cautionary labels on the packaging. Other welding materials which produce fumes or gases that are hazardous to health will also have cautionary labels. Ensure that you read these labels and the Material Safety Data Sheet(MSDS) for each welding or brazing material.

If the Permissible Exposure Limit(PEL) of a welding generated gas or fume is exceeded, respiratory protection must be used. Personnel may opt to wear respiratory protection when airborne contaminants do not exceed their OSHA PEL's. Please see Chapter 10 "*Respiratory Protection*" for KRC's policy on respiratory hazards and respiratory protection selection.

Air monitoring will be conducted when welding operations change, the Machine Shop ventilation is modified, or at the request of personnel. The UW Safety Department will assist the KRC Safety Specialist.

Respirators with appropriate cartridges and/or filters will be provided by KRC. Filtering facepiece respirators appropriate for dusts, mists or fumes generated during cutting or grinding may be checked out from the PSL Stockroom. Cartridge respirators appropriate for vapors and gases should be obtained through the KRC Safety Specialist. Please see Chapter 10 "*Respiratory Protection*" for KRC's procedure on respiratory protection selection.

General building ventilation in the machine shops will provide uncontaminated air for breathing, and air exhausted will be replaced by make-up air in compliance with COM 32 and ILHR 64. Local exhausts will provide local ventilation during welding activities. Local exhausts will be located in close proximity to the welding bench. Switches for controlling the local exhaust will be located next to the workbench. Local exhausts should be turned "off" when welding is finished or when welding is not occurring. If you use a fan for additional ventilation, ensure that fumes, vapors, or gases are directed away from you and other personnel.

Chlorinated hydrocarbons should not be used for degreasing parts immediately prior to welding. Chlorinated hydrocarbons are not to be stored in the immediate area of welding or in areas where ultraviolet light may interact with chlorinated hydrocarbons.

Fire hazards are to be removed from the area where welding operations take place. Flammable and combustible chemicals should be stored in "flammables cabinet" in the machine shops. Fire extinguishers should be in close proximity to welding operations.

No welding, cutting, or grinding is to be done on used drums, barrels, tanks or other containers until they have been thoroughly cleaned and determined to be absolutely free of flammable materials or any other materials which when heated would produce flammable or toxic vapors. All hollow spaces, cavities, and containers are to be vented to permit the escape of air or gases before heating, cutting, or welding.

Ensure that the material welded has cooled before you touch it. Make sure that you do not leave the area of any welded material until it has cooled.

Welding cables and other equipment should be placed so that it is clear of passageways. When work is completed, return cables and other welding equipment to where they were stored.

When welding operations are conducted in wet conditions, protection from electrical shock is to be used.

Screens designed to filter out injurious light rays produced by welding shall be arranged to shield other personnel or passersby from exposure to injurious light rays.

Clean up the work area when finished and return the welder to its original settings.

The valves of high pressure gas cylinders must be completely opened to the top valve seat when in use. When finished, completely close the valve to the bottom seat of the gas cylinder.

5. OXYGEN-ACETYLENE WELDING

All oxygen-acetylene welding equipment and operation must be in compliance with 29 CFR 1910. 253 “Oxygen-Fuel Gas Welding and Cutting” as well as complying with all requirements under 29 CFR 1910 Subpart Q “Welding, Cutting and Brazing”.

Following OSHA regulations, under no condition is acetylene to be utilized in excess of 15psi. Regulators must be used. Mixture of air and acetylene is to only occur at the burner or torch.

Only approved apparatus such as torches, regulators, and other hardware are to be used for oxygen-acetylene welding. All connections are to be in compliance with ANSI B57.1 “Compressed Gas Cylinder Valve Outlet and Inlet Connections”. Hose connections are to be clamped or otherwise securely fastened. Hoses showing leaks, burns, worn places or other defects shall be repaired or replaced.

Gas cylinders not in use are to be stored away from sources of heat, are to be stored in well ventilated dry locations at least 20 feet from combustible materials, and stored in an assigned place where cylinders will not be knocked over or damaged. The PSL building has an area for storage of flammable gas cylinders separate from nonflammable gas cylinders. SRC has a storage area for nonflammable gas cylinders near the entrance to the SRC Machine Shop.

Empty gas cylinders are to have their valves closed, and protective caps in place. When welding is completed the cylinder valve is to be fully closed. Place the empty cylinder in the appropriate

flammable or nonflammable empty gas cylinder rack at PSL or SRC. Ensure that full cylinders are not placed in the empty cylinder racks.

Nothing is to be placed on top of an acetylene cylinder when in use that could interfere with the quick closing of the valve. If a cylinder wrench is used for opening and closing the valve, it should be left in place on the valve stem at all times.

Cylinders, valves, couplings, regulators, hose, and torch are to be kept free from oily or greasy substances. Do not handle oxygen cylinders or equipment with oily hands or gloves. Do not allow a jet of oxygen to strike an oily surface or greasy cloths.

Acetylene gas cylinder valves should not be opened more than three-fourths of a turn, and must never be opened more than one and one-half turns. Regulators are to be used only for the gas and pressures for which they were intended.

6. ARC WELDING

All arc welding equipment and operation must be in compliance with 29 CFR 1910.254 “Arc Welding and Cutting” as well as complying with all requirements under 29 CFR 1910 Subpart Q “Welding, Cutting and Brazing”.

Voltages for alternating current machines are not to exceed 80 volts, and voltages for direct current machines are not to exceed 100 volts.

Control apparatus is to be enclosed except for operating wheels, levers or handles.

Input power terminals and live metal parts connected to input circuits are to be completely enclosed and accessible only by means of tools. A disconnect switch with overload protection is to be used for any outlet connection with a welding machine.

Terminals for welding leads should be protected from accidental electrical contact by personnel or metal objects. Use a recessed opening with nonremovable hinged cover, heavy insulating sleeving or taping, or other equivalent electrical and mechanical protection.

The frame or case of the welding machine must be grounded. The ground must be checked to determine that it is mechanically strong and adequate for the required current. Ensure a ground connects the welding machine to the metal worktable and/or workpiece.

Chains, wire ropes, cranes, and hoists are not to be used to carry welding current.

Coiled welding cable are to be spread out before use to avoid overheating and damage to insulation. Do not coil or loop welding electrode cable around parts of the body.

The electrode holder when not in use should be placed so that it cannot make electrical contact with persons, conducting objects, fuel, or gas cylinders.

Do not wear metal jewelry when arc welding.

Machines which have become wet should be thoroughly dried and tested before use.

Cables with damaged insulation or exposed conductors shall be replaced. Any equipment defect or hazard is to be reported to the Machine Shop supervisor and the use of the equipment is to be discontinued until its safety has been assured.

7. GAS SHIELDED WELDING

The gases used for gas shielded welding may displace oxygen in the room atmosphere. This could cause asphyxiation. Ensure that adequate ventilation is available.

The valves of high pressure gas cylinders are to be completely opened to the top valve seat when in use. When finished, completely close the valve to the bottom seat of the gas cylinder.

Clean up the work area when finished and return the welder to its original settings.

See applicable topics in the above welding safety policies.

8. SPOT WELDING

All resistance welding equipment and operation must be in compliance with 29 CFR 1910. 255 “Resistance Welding” as well as complying with all requirements under 29 CFR 1910 Subpart Q “Welding, Cutting and Brazing”.

Spot welders must be connected to overload protection circuits.

Ensure that accidental triggering will not result in contact with personnel or equipment. Keep the area around the electrodes free of clutter.

Any equipment defect or hazard is to be reported to the Operations Group Leader and the use of the equipment is to be discontinued until its safety has been assured.

9. SOLDERING

Soldering primarily takes place in the PSL Electronics Shop, SRC Electronics Shop area and User Electronics workbench. Local exhaust is provided at each workbench in those areas.

Fluxes containing fluoride compounds should be prevented from contacting the skin or eyes. If contact occurs, immediately flush with water and seek emergency care. Solder and fluxes may produce fumes or gases that are hazardous to health. Soldering materials which produce fumes or gases that are hazardous to health should have cautionary labels. Ensure that you read these labels and the Material Safety Data Sheet(MSDS) for each soldering material.

Avoid contact with melted solder, the flame or pipe of an ignited propane torch, or the tip of a

soldering iron when heated. Avoid handling the soldered part until it has cooled.

Close the valve of propane torches when not in use. Place the soldering iron in its holder when not in use. Do not place a hot soldering iron or propane torch on or near any flammable or combustible material. Turn "off" soldering irons when you leave the work area or when finished using.

When lighting propane torches, point the torch away from your body and other personnel. Do not use a match or flame to light a propane torch. Use a sparking gas lighter.

Soldering irons must be connected to overload protection circuits.

If the Permissible Exposure Limit(PEL) of a soldering generated gas or fume is exceeded, respiratory protection must be used. Personnel may opt to wear respiratory protection when airborne contaminants do not exceed their OSHA PEL's. Please see Chapter 10 "*Respiratory Protection*" for SRC's policy on respiratory hazards and respiratory protection selection.

Air monitoring will be conducted when soldering operations change, the SRC Electronics Shop or User Electronics workbench ventilation is modified, or at the request of personnel. The UW Safety Department will assist SRC Safety.

General building ventilation in the SRC will provide uncontaminated air for breathing, and air exhausted will be replaced by make-up air in compliance with COM 32 and ILHR 64. Overhead maneuverable exhausts will provide local ventilation during soldering activities at the SRC Electronics Shop workbenches and User Electronics workbench. Soldering operations in areas where local exhaust ventilation is installed are to use local exhaust ventilation.

Compressed air is not to be used for cleaning except where reduced to less than 30psi and then only while wearing appropriate eye protection.

Safety glasses shall be worn for all operations where flying object hazards exist. Safety glasses may be found in electronics shops, in machine shops, on workbenches, and in KRC portable tool carts.

Chapter 30. Portable Ladders and Scaffolds

1. Policy

It is the policy of the KRC to provide maximum protection for its personnel and Users. The Wisconsin Department of Commerce (DOC) has adopted the OSHA construction standards for the regulation of ladder and scaffold safety while personnel are involved in construction. Strict compliance with OSHA 1926.453 (Subpart L) and 1926.1053 (Subpart X), scaffold and ladder safety, respectively, is mandatory during construction at the KRC. General OSHA standards for ladder or scaffold use (29 CFR 1910.25 and 1910.26) are complied with during nonconstruction activities. By adhering to these regulations, prevention of the leading cause of occupational injury, falls, may be achieved.

2. Definitions

Extension ladder- A portable ladder usually consisting of two sections of straight ladder (portable rung ladder). Extension ladders may not exceed 60 feet (wood) or 48 feet (metal). The ladder must have two sections, one fitting within the side rails of the other and arranged so the upper section can be raised and lowered.

Fall protection- See Chapter 37, "Fall Protection". Fall protection is not required for ladders less than 20 feet, but is required for scaffold use 10 feet above a lower level.

Fixed ladder- A ladder that cannot be readily moved or carried because it is an integral part of a building or structure.

Folding stepladder- These are self-supporting, nonadjustable, portable ladders with a work platform on the top of the ladder. These may not exceed 20 feet. There are three types, see below. Step ladders must have a metal spreader or locking device capable of holding the front and back sections open.

Guardrail- A barrier erected to prevent personnel from falling to lower levels.

*Personal fall arrest system (PFAS)-*A system including but not limited to an anchor point, connectors, and a body harness used to arrest a worker in a fall from a working level.

Portable ladder- A ladder that can be readily moved or carried.

Scaffold- A temporary raised framework or platform on which workers sit or stand when performing tasks at heights above the ground. There are three types of scaffold: light, medium and heavy duty.

Step- A metal or wood crosspiece placed between two parallel side rails which personnel may step upon while ascending or descending a ladder. Rungs are circular in cross section, while cleats are rectangular in cross section. Steps must be corrugated, knurled, dimpled, coated with a skid-resistant material, or otherwise treated to prevent slipping.

Stepladder- See folding stepladder.

Step stool- A self-supporting, foldable, portable ladder, nonadjustable in length, 32 inches or less in overall size, with flat steps and without a pail shelf, designed to be climbed on the ladder top cap as well as all steps. The side rails may continue above the top cap.

Straight ladder- These ladders are designed to lean against a wall or edge of a roof, beam, or other solid top support. They vary in length but may not exceed 30 feet. These ladders must be set at the proper angle to prevent them from tipping over backwards or slipping out from the bottom. Also known as portable rung ladder.

Toeboard- A low protective barrier that prevents material and equipment from falling to lower levels and which protects personnel from falling.

Tubular metal ladder- These ladders are strong and usually have wide, stairway like steps to the work platform. Tubular ladders are nonfolding, portable, and nonadjustable.

Type I stepladder- An industrial stepladder, 3 to 20 feet in length, to be used for heavy duty work. Its weight capacity, including worker is 250 pounds.

Type II stepladder- A commercial stepladder, 3 to 12 feet in length, to be used for medium duty, such as painting. Its weight capacity, including worker is 225 pounds.

Type III stepladder- A household stepladder, 3 to 6 feet in length, to be used for light duty. Its weight capacity, including worker is 200 pounds. The pail shelf and spreader may be combined in one unit only in Type III stepladders.

Unprotected sides and edges- Any side or edge of a walking/working surface where there is no wall or guardrail system at least 1 meter high.

Walking/working surface- Any surface, whether horizontal or vertical, on which personnel walk or work, including but not limited to floors, roofs, or ramps. It does not include ladders or vehicles on which personnel must be located to perform their work duties.

3. Portable Ladders

Use

It is important to select and use correctly the proper ladder for the task. General rules to follow include, choosing a ladder long enough to provide access to the work area without necessitating standing on the top two steps of a stepladder or the top three rungs of a straight ladder.

Secondly, when a straight ladder is used to gain access to a roof, the side rails should extend at least three feet above the support point at the eave, gutter, or roof line. Never splice together short ladders to form a longer ladder. Never place ladders on boxes, barrels, or other unstable bases for additional height. Thirdly, ladders should be placed on level surfaces only. Although ladder feet or shoes provide an important measure of safety, they cannot compensate for uneven ground.

Additionally, be alert to slippery surfaces. Nonslip bases are not a substitute for safety in placing, lashing, or holding a ladder on oily, metal, concrete, or other slippery surfaces.

Other safety rules regarding ladder use include:

- Do not use a metal ladder when working on or near electrical equipment.
- The distance from the bottom of a straight ladder to its support wall should be one-quarter the working length of the ladder.
- Where possible, straight ladders should be secured with a rope or wire at the top and blocked at the bottom.
- The top two steps and platform of a stepladder are not to be used, and the top three rungs of a straight ladder are not to be used.
- Do not over-reach, jump or slide down a ladder while on it. Ladders are not to be moved, shifted, or extended while occupied.
- Always face the ladder and use both hands while ascending or descending.
- Tools or materials should be raised by means of a rope after the climber has reached the working position.

- Barricades and warning signs should be posted when ladders are placed near doors or other locations where they could be struck.
- Two workers are to handle and set up all extension ladders.
- Ladders should not be used by more than one person at a time.
- The bracing on the back side rails of stepladders is designed only for increasing stability, not for climbing.
- Ladders are not to be used horizontally as platforms, runways, or scaffolds.
- Two section extension ladders (up to and including 36 feet) are to have 3 feet of overlap. Thirty-six to forty-eight foot ladders are to have 4 feet of overlap.
- Make certain that both automatic locks of the extension ladder are in proper position before ascending the ladder.
- While in use, all straight ladders and stepladders that exceed 10 feet are to be held in place by another person.
- The area around the top and bottom of the ladder is to be kept clear.
- Hard hats are to be worn within an area beneath elevated work where objects could fall from a height and strike a worker.

Inspection

Prior to use of any ladder, an inspection is to be performed. Carefully examine the ladder for broken or missing rungs or cleats, broken side rails, and other damaged parts. In addition, all cleats, rungs, and side rails are to be free of grease, oil, paint, or other slippery substances. The ladder should be equipped with feet that are secured in place. The joint between steps and side rails is to be tight, and all hardware and fittings should be attached firmly. Movable parts should operate freely without binding or undue play. All wood parts are to be free of sharp edges and splinters. Visually inspect the ladder to be free of shakes, warpage, decay or other irregularities. Metal ladders are to be free of sharp edges, burrs and corrosion. Inspect for dents or bends in side rails, rungs or cleats. Check step to side rail connections, hardware connections and rivets. If a ladder falls, inspect the ladder for damage before continuing work.

Damaged ladders are to be withdrawn from service and either repaired or destroyed. When a defect or unsafe condition is found, personnel should tag or mark the ladder so that it will not be used until the corrective action is taken. Field repairs and the fabrication of improvised ladders is prohibited.

Maintenance

All ladder repairs should be done by a qualified person. Do not make improvised repairs. Never try to straighten a bent or bowed ladder. Remove it from service immediately. Do not paint wooden ladders with solid color paints. This may mask cracks in the wood and make them hard to see. Clear wood preservative can be used to protect bare wood. If exposed to greases, oils or other slippery substances, the ladder is to be cleaned of the substance with solvents or steam. If the slippery substance is not completely removed, the ladder is to be removed from service.

Storage

Ladders should be stored where they can be inspected easily and can be reached without causing accidents. If ladders are stored horizontally, they should be supported at several points to avoid sagging. The storage area should be well ventilated and away from sources of heat and moisture.

Training

Personnel will be trained in the proper selection, use, maintenance and inspection of ladders. This training should be given by either the KRC Safety Specialist or personnel supervisors. Fall protection training, if necessary, will be conducted annually by the KRC Safety Specialist or a Wisconsin Bureau of State Risk Management authorized training resource. See Chapter 37, "Fall Protection".

4. Scaffolds

Use

It is important to select and use correctly the proper scaffold for the task. Choose the proper type of scaffold based upon the type of work to be conducted and the work load to be supported.

- Light duty scaffolds are intended for workers and tools only. The design load should be that it will support a working load of 25 pounds per square foot.
- Medium duty scaffolds are intended for workers, tools and construction materials. The design load should be that it will support a working load of 50 pounds per square foot.
- Heavy duty scaffolds are intended for workers, tools, stored materials, and construction materials. The design load of the scaffold should be that it will support a working load of 75 pounds per square foot.

All scaffolds must be capable of supporting at least four times the design load.

General rules to follow include, but are not limited to:

- Never work alone when conducting an operation on a scaffold.
- Never move a scaffold while personnel are on it.
- Follow all manufacturer's guidelines and warnings if the scaffold is commercially produced.
- The maximum work level height is not to exceed 4 times the least base dimension of the scaffold. Example: A four foot by six foot scaffold cannot exceed sixteen feet in height at the work platform level.
- The minimum working platform width is two feet.
- The supporting structure for the scaffold is to be rigidly braced, using adequate cross bracing or diagonal bracing with rigid platforms at each work level.
- Working platforms should have a nonslip surface.
- Scaffolds should be used only on an even surface.
- The platform surface should be kept clear of extraneous tools and materials.
- The work level platform is to be wood, aluminum, plywood planking, steel or expanded metal for the full width of the scaffold, except for necessary openings.
- Work platforms are to be secured in position.
- All work platform planking should be in compliance with 29 CFR 1926.453(a)(3)(v).
- All scaffolds, where work is conducted in excess of 10 feet in height, are to have 4 inch toe boards.
- All scaffolds, where work is conducted in excess of 10 feet in height, are to have guardrails.
- Follow all manufacturer guidelines in the assembly of the scaffold. Do not use or assemble the scaffold, if unsure of the correct assembly procedure.

- Fall protection is required for all scaffold use 10 feet above a lower level. Fall protection includes engineering controls, work practices, and personal fall arrest systems. Refer to Chapter 37, "*Fall Protection*" for details.
- Hard hats are to be worn within an area beneath elevated work where objects could fall from a height and strike a worker.

Inspection

Prior to the use of any scaffold, an inspection is to be conducted, and then daily during usage of the scaffold. Carefully examine the scaffold for broken or missing cross bracing, broken supporting structure, working platform, and other damaged parts. In addition, all walking and working surfaces are to be free of grease, oil, paint, or other slippery substances. The scaffold should be equipped with positive wheel lock casters that are secured in place. The joint between working platform and supporting structure is to be tight, and all hardware and fittings should be attached firmly. Movable parts should operate freely without binding or undue play. All wood parts are to be free of sharp edges and splinters. Visually inspect the scaffold to be free of shakes, warpage, decay or other irregularities. Metal parts are to be free of sharp edges, burrs and corrosion. Inspect for dents or bends in supporting structure, cross braces and walking/working surfaces. Check all working platform to support structure connections, hardware connections and rivets. If a scaffold falls, inspect the scaffold for damage before continuing work.

Damaged scaffolds are to be withdrawn from service and either repaired or destroyed. When a defect or unsafe condition is found, personnel should tag or mark the scaffold so that it will not be used until corrective action is taken. Field repairs and the fabrication of improvised scaffolds is prohibited.

Maintenance

All scaffold repairs should be done by a qualified person. Do not make improvised repairs. Never try to straighten a bent or bowed cross brace or supporting structure. Remove it from service immediately. Replace any damaged working platform. If exposed to greases, oils or other slippery substances, the working platform is to be cleaned of the substance with solvents or steam. If the slippery substance is not completely removed, the working platform is to be removed from service.

Storage

Scaffolds should be stored where they can be inspected easily and can be reached without causing accidents. The storage area should be well ventilated and away from sources of heat and moisture. Scaffolds should be disassembled prior to storage.

Training

Personnel will be trained in the proper selection, use, maintenance, assembly, and inspection of scaffolds. This training should be conducted by either the KRC Safety Specialist or personnel supervisors. Fall protection training, if necessary, will be conducted annually by the KRC Safety Specialist or a Wisconsin Bureau of State Risk Management authorized training resource. See Chapter 37, "*Fall Protection*".

Chapter 31. Laser Safety

1. Policy

Lasers can present health and safety hazards to personnel. This chapter will outline methods for assessing and controlling the hazards associated with lasers for the protection of potentially exposed personnel. Installation and operation of lasers must be in compliance with the current ANSI Z136.1 standard.

2. Laser Hazard Classification and Primary Precautions

A laser (Light Amplification by the Stimulated Emission of Radiation) is a device that emits electromagnetic radiation having wavelengths ranging from 100nm to 1×10^6 nm. The beam is generally of a single wavelength or limited number, and is highly concentrated compared to conventional light sources. Light regions are divided as follows:

Ultraviolet

UV-C 100nm to 280nm

UV-B 280nm to 320nm

UV-A 320nm to 380nm

Visible 380nm to 760nm

Infrared

IR-A 760nm to 1400nm

IR-B 1400nm to 3000nm

IR-C 3000nm to 1×10^6 nm

Lasers are identified by type, i.e. Helium-Neon, wavelength(s), and Laser Hazard Classification. The Laser Hazard Classification is determined by the wavelength(s), maximum duration of exposure (for Class II lasers this is 0.25 seconds), and the average power output of the laser. Manufacturers of lasers are required to label all lasers with the appropriate Laser Hazard Classification "Caution" or "Danger" warning. If an unlabeled laser is found, contact the KRC Safety Specialist. Class I, II, and IIIa lasers should have a yellow and black "Caution" label, while Class IIIb, and IV lasers should have a red, black, and white "Danger" label. The universal symbol for a laser hazard is a sunburst pattern of short spokes with a single long spoke radiating from the center of the sunburst.

Class I

Exempt lasers that cannot produce a hazard
No primary precautions

Class II

Low power visible laser which, due to the reflex response, does not normally present a hazard unless viewed directly.
Do not stare into the beam.

Class IIIa

Lasers that normally do not produce a hazard if viewed momentarily with the unaided eye; may produce a hazard if viewed using collecting optics.

Do not stare into the beam or view directly with optical equipment.

Class IIIb

Lasers that can produce an eye injury if viewed directly, including intrabeam viewing of specular reflections.

Avoid direct exposure to the beam.

Class IV

Laser that can produce an eye injury or skin burns from direct, specular or diffuse reflections; may be a fire and skin hazard.

Avoid eye or skin exposure to direct, reflected or scattered radiation.

Class II lasers are frequently used at KRC for alignment purposes. Apply simple precautions and they are a safe tool to use. Class IIIa, IIIb, and Class IV lasers may be in use at KRC.

3. Laser Safety Control Measures

Class I

- Prior to operation, the laser shall be classified as to its hazard class, and equipped with the appropriate warning label.
- Prior to maintenance, repair, or modifications, a safety plan should be developed to ensure personnel will not be exposed to health or safety hazards.
- A protective housing shall encase the laser.
- The housing shall be interlocked to prevent operation of the laser while the housing is removed.

Class II

- The laser safety control measures for Class I lasers shall be complied with in addition to the following.
- Do not stare into the beam.
- Control all unnecessary shiny reflecting surfaces from the work area and yourself.
- A nonreflective surface should be used as a beam stop. The area along all parts of the path of the beam should be cleared of personnel and reflective material.
- Do not use at eye height.
- Post "Caution" signs alerting personnel to the use of Class II lasers in the work area.
- A protective housing shall encase the laser.
- The housing shall be interlocked to prevent operation of the laser while the housing is removed.

Class IIIa

- The laser safety control measures for Class II lasers shall be complied with in addition to the following.
- Do not stare into the beam.
- Control all unnecessary shiny reflecting surfaces from the work area and yourself.

- A nonreflective surface should be used as a beam stop. The area along all parts of the path of the beam should be cleared of personnel and reflective material.
- Do not use at eye height.
- Post "Caution" signs alerting personnel to the use of Class IIIa lasers in the work area.
- Personnel should have access to laser safety glasses for the appropriate wavelength.
- Personnel using a Class IIIa laser should receive laser safety training.
- A protective housing shall encase the laser.
- The housing shall be interlocked to prevent operation of the laser while the housing is removed.

Class IIIb

- The laser safety control measures for Class IIIa lasers shall be complied with in addition to the following.
- The path of the laser beam shall be enclosed, and inaccessible to personnel.
- Control all unnecessary shiny reflecting surfaces from the work area and yourself.
- A protective housing shall encase the laser.
- The housing shall be interlocked to prevent operation of the laser while the housing is removed.
- A permanent non-reflective beam stop shall be incorporated.
- Post "Danger" signs alerting personnel to the use of Class IIIb lasers in the work area.
- If used with a chamber, all windows not in use shall be constructed of or covered with material that will not transmit light of the wavelength generated by the laser.
- Personnel shall have access to laser safety glasses for the appropriate wavelength.
- The area of the laser shall not be in personnel traffic areas.
- The user of the Class IIIb laser shall provide documentation to the KRC Safety Specialist regarding safety measures taken and planned.
- Personnel using a Class IIIb laser shall receive laser safety training.
- The KRC Safety Specialist shall be notified when alterations which may affect safety are made to equipment.

Class IV

- The laser safety control measures for Class III lasers shall be complied with in addition to the following.
- A protective housing shall encase the laser.
- The housing shall be interlocked to prevent operation of the laser while the housing is removed.
- The path of the laser beam shall be enclosed, and inaccessible to personnel. This enclosure shall be interlocked.
- A permanent non-reflective beam stop shall be incorporated.
- An alarm or revolving light shall be in use during operation of the laser.
- If used with a chamber, all windows not in use shall be constructed of or covered with material that will not transmit light of the wavelength generated by the laser.
- Personnel shall have access to laser safety glasses for the appropriate wavelength.
- The area of the laser shall not be in personnel traffic areas, and is considered a Laser Controlled Area.

- The user of the Class IV laser shall provide documentation to the KRC Safety Specialist regarding safety measures taken and planned.
- Personnel using a Class IV laser shall receive laser safety training.
- The KRC Safety Specialist shall be notified when alterations which may affect safety are made to equipment.
- Post "Danger" signs alerting personnel to the use of Class IV lasers in the work area.

4. Biological Effects of Laser Radiation

Effects Of Laser Radiation On The Eye

Most damage to the eye results from acute exposure to laser radiation. Generally the aversion response prevents long periods of exposure to laser radiation.

Corneal damage may be due to far-infrared (IR-C) or ultraviolet (UV) irradiation. Damage from IR-C exposure results in a loss of transparency or produces a surface irregularity in the cornea. Damage is caused by heating resulting from absorption of the light energy by tears and tissue water in the cornea. A sensitive material or protein is denatured by the absorption of heat, resulting in coagulation[and loss of transparency] or surface irregularity. Damage from UV exposure results in photophobia accompanied by surface redness, tearing, conjunctival discharge, cloudiness in the main body of the cornea, and the peeling of the surface layer of cells of the cornea. The damage is the result of a photochemical denaturation rather than heat absorption. A denaturation of sensitive proteins or other molecules occurs in the outer cell layers of the cornea.

Retinal damage may be caused by visible or near-infrared (IR-A and IR-B) irradiation. Damage results in a retinal lesion, which occurs within 24 hours of exposure. The lesion is the result of local heating of the retina due to absorption of the light and its conversion to heat in the epithelium.

Additionally, in the wavelength regions separating visible from ultraviolet, and near-infrared from far-infrared, both corneal and retinal damage may occur. Damage to the lens and iris can occur in these wavelength regions also.

Effects Of Laser Radiation On The Skin

Biological effects on the skin due to infrared and/or visible laser radiation is considerably less damaging than that to the eye. Skin damage from acute IR or visible irradiation is usually reversible. Effects range from reddening of the skin to blisters and charring. Ulceration and scarring of the skin may occur from extremely high power laser radiation. Effects of chronic exposure to IR or visible laser irradiation are unknown at this time.

Biological effects on the skin due to ultraviolet laser radiation are not as clearly defined. Chronic exposure to UV irradiation can have a carcinogenic response on skin, as well as causing reddening of the skin. Acute exposure to UV irradiation is not as well documented. According to studies of non-laser generated UV light, exposure to UV-B (280nm to 320nm) is the most injurious to skin. It appears that UV-C (100nm to 280nm) is absorbed in the outer dead layer of the epidermis, while UV-A (320nm to 380nm) causes darkening of epidermal pigment.

5. Procedure For Using a Laser or Laser System

To safely use a laser or laser system at the KRC, and to protect personnel in the area from laser hazards, a Laser Safety Plan must be utilized. The Laser Safety Plan for Class I and II lasers is satisfied by following the established KRC Laser Safety Control Measures. No written documentation is required for Class I or II lasers. More involved Laser Safety Plans are required for Class IIIa, IIIb, and IV lasers or laser systems. Listed below are the components required in the written Laser Safety Plan submitted to the KRC Safety Specialist before work may begin with the applicable class laser.

Class I

See Laser Safety Control Measures for Class I lasers. No written Laser Safety Plan is required. Ensure a "Caution" label is attached to the laser housing.

Class II

See Laser Safety Control Measures for Class II lasers. No written Laser Safety Plan is required. Ensure a "Caution" sign appropriate for Class II lasers is posted in the work area.

Class IIIa

See Laser Safety Control Measures for Class IIIa lasers. Ensure a "Caution" sign appropriate for Class IIIa lasers is posted in the work area. Documentation should be provided to the KRC Safety Specialist which should include a diagram of the intended setup, evidence of laser safety training for involved personnel, a description of the Class IIIa laser, and evidence of laser safety protective eyewear for involved personnel.

Class IIIb

A written Laser Safety Plan shall be submitted to the KRC Safety Specialist or the facility safety officer prior to operation of a Class IIIb laser or laser system. The written plan shall contain a diagram of the intended setup, documented laser safety training of involved personnel and an outline of the laser safety training program, documentation describing the intended experiment and use of the Class IIIb laser or laser system[including a description of the Class IIIb laser or laser system], a checklist indicating that all steps required by the Laser Safety Control Measures for Class IIIb lasers have been completed, and documentation outlining the engineering controls, personal protective equipment, and administrative procedures implemented to safeguard users of the laser and personnel in the area. No experiments with or testing of a Class IIIb laser or laser system shall begin without a written plan received and approved by the KRC Safety Specialist. Ensure a "Danger" sign appropriate for Class IIIb lasers is posted in the work area.

Class IV

A written Laser Safety Plan shall be submitted to the KRC Safety Specialist or the facility safety officer prior to operation of a Class IV laser or laser system. The written plan shall contain a diagram of the intended setup, documented laser safety training of involved personnel and an outline of the laser safety training program, documentation describing the intended experiment and use of the Class IV laser or laser system[including a description of the Class IV laser or laser system], a checklist indicating that all steps required by the Laser Safety Control Measures for Class IV lasers have been completed, and documentation outlining the engineering controls, personal protective equipment, and administrative procedures implemented to safeguard users of

the laser and personnel in the area. No experiments with or testing of a Class IIIb or IV laser or laser system shall begin without a written plan received and approved by the KRC Safety Specialist. Ensure a "Danger" sign appropriate for Class IV lasers is posted in the work area.

6. Definitions

Absorption- Transformation of radiant energy to a different form of energy by interaction with tissue.

Aperture- The opening through which radiation passes.

Average power- The total energy imparted during exposure divided by the exposure duration.

Aversion response- Closure of the eyelid[blink] or movement of the head to avoid exposure to a noxious stimulant or bright light. It can occur within 0.25 seconds.

Beam- A collection of rays which may be parallel, divergent or convergent.

Caution- Signal word to be used with Class I, II, and IIIa lasers or laser systems. Caution signals alert personnel to the presence of a hazard which may cause moderate or minor injury.

Classification duration- The maximum duration of exposure inherent in the design of the laser.

Coagulation- The process of congealing by an increase in viscosity, while a liquid is going from liquid to gel or solid state.

Conjunctiva- The mucous membrane that lines the inner surface of the eyelid and the exposed surface of the eyeball.

Cornea- The transparent, convex, anterior portion of the outer fibrous coat of the eyeball that covers the iris and the pupil and is continuous with the sclera

Corneal lesion- Eye wound involving the cornea. Described as a white area involving only the epithelium (outermost cell layer) and whose surface is not elevated or swollen. It generally appears within several hours of exposure. A small lesion will heal within 48 hours without visible scarring.

CW laser- Continuous wave laser, which emits optical radiation for a period exceeding 0.25 seconds.

Danger- Signal word to be used with Class IIIb, and IV lasers or laser systems. Danger signals alert personnel to the presence of an immediate hazard, which if not avoided, could result in death or serious injury.

Denaturation- Functional modification of the properties of protein by structural alteration via heat or chemical process.

Diffuse reflection- Reflection which takes place when a laser beam is reflected from a surface over a wide range of angles.

Enclosure- A device or structure which does not permit optical radiation to escape. If used with a Class IV or IIIb laser, the enclosure must be interlocked with the laser power supply.

Epithelium- The outermost layer of cells of a tissue.

Intrabeam viewing-Viewing a laser beam where the eye is exposed to all or part of a laser beam.

Iris- The pigmented, round, contractile membrane of the eye, suspended between the cornea and lens and perforated by the pupil. It regulates the amount of light entering the eye.

Laser- Source of an intense directional beam of optical radiation by stimulating electronic or molecular transitions to lower energy levels. A laser is composed of a power supply, resonant cavity, and a lasing medium.

Laser controlled area- Area which contains one or more lasers, and where activity and personnel are subject to control and supervision.

Laser Safety Plan- Document outlining safety procedures and equipment design to prevent hazard to personnel using a laser or laser system or to personnel in the area.

Laser system- An assembly of electrical, mechanical and optical components which includes a laser.

Lens- A transparent, biconvex body of the eye between the iris and the vitreous humor that focuses light rays entering through the pupil to form an image on the retina.

Lesion- An abnormal change in the structure of an organ due to injury, a.k.a. wound.

Nanometer- Unit of length equal to 1×10^{-9} m. Symbol nm.

Open installation- Any location where lasers are used and that are accessible during operation. Not an area that is closed off to personnel.

Optical radiation- Ultraviolet (UV), visible, and infrared (IR) radiation.

Output power- The laser output power is used primarily to rate CW lasers since the energy per unit time remains relatively constant. The output power of pulsed lasers deliver their power in pulses and are categorized by energy output per pulse. Power output of CW lasers is generally measured in milliwatts, while pulsed lasers are measured in megawatts.

Photophobia- Over sensitivity to bright or normal light levels.

Protective housing- A device designed to prevent access to energy at levels higher than the posted Laser Hazard Classification.

Pulsed laser- Laser that delivers its energy in repeated, short pulses. Generally each pulse emits a burst of energy for less than 0.25 seconds.

Pupil- The apparently black circular opening in the center of the iris of the eye, through which light passes to the retina.

Reflection- Deviation of radiation following incidence on a surface.

Retina- A delicate, multilayered, light-sensitive membrane lining the inner eyeball and connected by the optic nerve to the brain.

Retinal lesion- Eye wound involving the retina. Described as a white coagulated patch involving the epithelium. It generally appears within 24 hours of exposure. The most serious damage to vision occurs in the central portion of the retina.

Sclera- The tough, white, fibrous outer envelope of tissue covering all of the eyeball except the cornea.

Specular reflection- A mirror like reflection.

Watt- Unit of power equal to one joule per second.

Wavelength- The distance between two points in a periodic wave which have the same phase.

Chapter 32. SRC Radiation Safety

(Revised 4/23/2012)

POLICY

Radiation at the Synchrotron Radiation Center is hazardous ionizing energy that is produced when electrons are lost either during injection, beam dumping, or during user beams. The SRC works in conjunction with the UW Safety Department Radiation Safety Manager on matters regarding exposure to radiation. The SRC goal is to control radiation doses as low as reasonably achievable in accordance with the Nuclear Regulatory Commission (NRC) regulations. SRC follows the “ALARA” (As Low as Reasonably Achievable) radiation exposure philosophy. Radiation exposure is lowered by reducing the duration of exposure (evacuation of the vault during injection), limiting access to areas where radiation exposure may result, and creating effective radiation shielding. Additionally, warning devices to alert personnel to the potential for radiation exposure, interlocks, and exclusion devices serve to reduce radiation exposure. New users and staff will be instructed in the potential radiation hazard of the SRC during the New User/Staff Safety Orientation.

EXPOSURE

Biological Effects of Radiation at SRC

- X-rays and neutrons do not have as much ionizing potential as, for instance, alpha particles. However, due to their penetration ability, x-rays and neutrons may cause ionizations within the body. Exposure to these radiations may cause skin reddening or burns. Potential for severe eye damage exists if the eyes are exposed to radiation. **NEVER LOOK AT THE BEAM!!** As with all radiation types, biological effects of the exposure depend upon radiation type, energy level, distance from source, duration of exposure, and area exposed. There should be no long term biological effect from working at the SRC.

Regulated Allowable Radiation Exposure

- The maximum permissible dose for adult non-radiation workers is 100 mRem per year. The maximum permissible radiation exposure for adult radiation workers is 5000 mRem per year. The maximum permissible radiation exposure for pregnant radiation workers is 500 mRem per gestation period. These dosages have been established by the NRC and Wisconsin Department of Health and Social Services. For the average person, annual exposures of 294 mRem/year and 63 mRem/year are due to cosmic radiation and medical/dental x-rays, respectively.
- The Synchrotron Radiation Center, as part of the “ALARA” philosophy, established the goal of limiting radiation exposure to no more than 1000 mRem/year for personnel working in the Aladdin vault. These persons are considered radiation workers, yet the SRC desires to prevent radiation exposures exceeding twenty percent of permissible radiation exposure. The University of Wisconsin investigates all radiation exposures exceeding 100 mRem per month.
- The permissible radiation exposure limit (set by the NRC) for workers is set so there will be no somatic (skin burn, hair loss, etc.) effects, even if the worker is exposed to the maximum permissible exposure year after year. Additionally, although statistics suggest that the worker population would be at an increased risk for cancer, at the permissible exposure limit no increases in cancers have been detected in radiation worker populations.

Radiation and Pregnancy

- Pregnant women should notify the SRC Safety Manager in writing, so affected personnel can receive information and training on radiation, chemical, and physical hazards for pregnant women at the worksite. A medical doctor's note giving the due date is recommended. Upon review of materials, the UW Safety Department-Radiation Safety or the KRC Safety Manager shall answer any questions from personnel. Affected personnel will make decisions regarding radiation exposures that are acceptable. See above for regulated allowable radiation exposure for pregnant radiation workers. Reasonable accommodations will be made at the work area or duties.

Visitors

- All visitors must sign in by signing the guest book located in the lobby of the building.
- Visitors will not be allowed beyond the general lobby areas of the buildings unless they are accompanied by a KRC employee or authorized user. An authorized user is a user that has registered with the SRC and has been issued a guest namebadge.
- Visitors that have not made prior arrangements to be accompanied by a KRC employee or authorized user must check with either the secretary or the Operator on Duty (OOD) at SRC. These personnel will then refer the visitor to Chris Moore, Educational Outreach Coordinator, for further assistance. These people are typically available during normal office hours, which are from 8:00 a.m. to 4:30 p.m. Monday through Friday. Visitors that have not made prior arrangements with KRC staff or authorized users will not be allowed in the buildings after normal office hours.
- Visitors causing a disturbance will be asked to leave. If the visitor refuses to leave and appears to pose an immediate threat, employees should call 911. If the visitor refuses to leave but does not appear to pose an immediate threat, employees should contact the KRC Safety Manager at extension 2157, or University Police and Security at 262-2957. Visitors wishing to tour the Aladdin vault must comply with the Aladdin Tour Policy, which follows.

Article I. Aladdin Tour Policy

1. Inform Chris Moore of all tours as soon as possible. Also contact Chris if you would like him to give or assist in organizing a tour.
2. Only KRC employees and users with SRC issued radiation badges will be allowed to give tours of the Aladdin vault. Self-guided tours are not allowed.
3. Tour guides must wear their radiation badges. Tour participants do not have to wear radiation badges but must stay with the tour guide at all times.
4. An '**Aladdin Tour Sign-in Sheet**' must be filled out for each tour by the tour guide. These forms are available below the SRC mailboxes. Completed forms should be placed in Chris Moore's mailbox. Although encouraged, SRC will not require an '**Aladdin Tour Sign-in Sheet**' to be filled out, or a pocket dosimeter carried, for small tours of 1 or 2 professional colleagues.
5. If there is beam in the machine **tour guides must carry pocket dosimeters**. Pocket dosimeter values must be recorded on the '**Aladdin Tour Sign-in Sheet**' before and after the tour. Pocket dosimeters will be checked out and returned to the SRC Operator on Duty.
6. If there is no beam in Aladdin, the use of pocket dosimeters is not required. However, an '**Aladdin Tour Sign-in Sheet**' must still be filled out.

7. All tour participants names must be printed on the 'Aladdin Tour Sign-in Sheet'. This can be done by the tour guide if desired.
8. Tour participants should be cautioned that this is a working lab and that hazards do exist. These hazards include but are not limited to; radiation, magnetic, electrical, and chemical.
9. No special considerations are required for tours that include minors.
10. People with pacemakers, which can malfunction in magnetic fields, are not allowed in the vault at any time. Strong magnetic fields can be present with or without beam in the ring.
11. Tour groups should be kept to ten people or less per guide. When necessary, use multiple tour guides. Contact Chris Moore to arrange for additional tour guides.
12. If possible, tours that include multiple groups will be done during development weeks to minimize the disruption to researchers using the machine. If necessary, no beam mornings will be scheduled for large, multiple group tours.
13. Scheduling of no beam tours should be done with user quantum in mind, that is, no beam mornings are better near the beginning of a user quantum than near the end.
14. Air-handling room (these stairs are steep and hazardous), equipment room (noise levels are quite high), and machine shop will not be included on tours.
15. Tours guides should sign the SRC visitor's log located near the front door of the SRC.

RADIATION PRODUCTION

- Large numbers of electrons are lost during injection, resulting in high radiation levels around the storage ring. For this reason, all personnel shall evacuate from the vault during injection.
- Radiation produced by electron interactions at the SRC (Bremsstrahlung radiation, X-rays and neutrons) may cause ionizations within the body if exposed. The synchrotron radiation (IR, visible, UV, and x-ray) and Bremsstrahlung radiation that go down the beamlines is also hazardous. Exposure to these radiations may cause skin reddening or burns if directly exposed to the light, in addition to the ionizations that the Bremsstrahlung radiation may cause. Potential for severe eye damage exists if the eyes are exposed to synchrotron radiation. Never look directly into the beam of light.
- In addition to synchrotron radiation produced at the SRC, other radiation is created as electrons orbit the ring. As electrons orbit the ring, electrons are lost from interactions with stray gas molecules, ionized molecules (from previous electron-gas interactions), and from impacts with ring components. These interactions create the Bremsstrahlung radiation, x-ray radiation, and neutrons, which are the greatest concern from a radiation safety standpoint. Bremsstrahlung radiation is intense x-ray radiation that is aimed forward in the direction of travel of the beam. Bremsstrahlung radiation is highest at the ends of the long straight sections. Soft and hard x-ray radiation is not directed along the path of the beam like Bremsstrahlung radiation, but is scattered although most is forward directed. X-rays are also generated in the microtron vault when electrons are accelerated during injection. Neutrons are created primarily during injection. This is one of the reasons why personnel must evacuate the vault prior to injection. When the beam of electrons is injected into the ring, the process is inefficient and many electrons are lost. When electrons strike the linac in the microtron or the inflector, photons are emitted. If the photons have sufficient energy and strike a nucleus, neutrons are ejected and scattered in all directions. Some neutrons are also created when low energy electrons orbiting the ring hit a gas molecule, are deflected and strike a ring component. The resulting photons may cause the emission of neutrons.

“ALARA” PHILOSOPHY

- SRC follows the “ALARA” (As Low as Reasonably Achievable) radiation exposure philosophy. There are three principles SRC follows for reducing radiation exposure. The first of these, limiting exposure time, is done by evacuating the vault during the injection process or during a planned beam dump. The dumping of the existing beam and/or injection of a new beam poses an elevated risk of exposure to radiation. For this reason, the vault is evacuated. Secondly, chains and barriers are erected to prevent personnel from accidentally nearing the ring or areas of potential radiation exposure. Radiation exposure decreases as you move away from it. As the distance from the source doubles, the radiation intensity decreases by a factor of four. At one meter from the ring, personnel would receive less than 20 mRem per amp of lost beam. At two meters from the ring, the exposure would be 5mRem. Finally, radiation shielding absorbs radiation. The density and thickness of shielding is dependent upon the type and energy of the radiation present. Additionally, warning devices to alert personnel to the potential for radiation exposure, interlocks, and exclusion devices serve to reduce radiation exposure. A permit is required to remove or modify any radiation shielding. Any personnel who need to modify radiation shielding must seek the assistance of the Operator on Duty. In general, conduct your work as far from the ring as possible, but if work must be done near the ring, do it as quickly as possible.

RADIATION BADGES

- Due to the documented history of minimal to no radiation exposure to individuals working and performing research in the SRC Aladdin vault, the University of Wisconsin-Madison Office of Radiation Safety has determined that no radiation exposure hazards exist in the Aladdin vault during beam time when the vault is open. Therefore, radiation dosimeters are no longer issued to SRC users, SRC staff members who spend minimal time in the Aladdin vault and CNTech Annex, and visitors. This change in policy is affirmed by the radiation codes found in Wisconsin DHS 157.25(2)(a), which require radiation monitoring of adults who are likely to receive, in one year, a dose in excess of 10% of the occupational dose limit. Ten percent of the adult occupational dose limit is 500 mrem per year, and personnel working in the Aladdin vault and CNTech Annex at the SRC typically receive a radiation dose equivalence of less than 25 mrem per year. This is considerably lower than the 20 mRem/week exposure which the US Department of Energy considers an acceptable limit for radiation workers.
- The National Science Foundation (NSF) requires the SRC to obtain personal information on staff and users. Therefore, staff and users must see the Operator on Duty (OOD) to complete a personal data form. The Operator on Duty will then issue a name badge to all SRC users and SRC staff members who spend minimal time in the Aladdin vault. The name badge will contain an expiration date. At that time, you will need to see the OOD to once again verify your personal information and obtain a new name badge.
- A badge rack is located on the lower level of Aladdin for the convenient storage of User and staff radiation badges.
- Radiation badges are changed quarterly. See an SRC Operator for a new badge. Lost or found badges, and badges left in the vault during an injection should be reported immediately to the SRC Radiation Safety Manager. Lost badges and badges left in the vault during an injection are to have a report filed with the UW Safety Department.

- Radiation badge exposures are posted on the lower level of Aladdin.

INTERLOCKS, RADIATION SHIELDING AND EXCLUSION DEVICES/ZONES

An interlock is a circuit or device constructed and installed to prevent operation of a device while safeguards are not in place. Interlocks work in combination with shielding and exclusion devices for protection. Radiation shielding absorbs radiation. The density and thickness of shielding is dependent upon the type and energy of the radiation present. Shielding for x-ray and gamma radiation needs to be a thick, dense material. An exclusion device is a construction or device that is used as a physical barrier to accidental exposure while radiation is present. An exclusion device can sometimes act or be part of radiation shielding.

SRC radiation shielding and exclusion devices shall not be removed by users. Do not tamper with radiation shielding, interlocks, exclusion devices or signs. Authorized SRC personnel following appropriate procedures may remove shielding and/or exclusion devices.

If it is found necessary to remove SRC beamline radiation shielding or exclusion devices:

- The beamline manager is to be informed
- The beamline manager will then inform the SRC Operator On Duty, who will fill out a "Front End Disabled" tag and attach the tag to the front end power module. Finally, the OOD will pull out the module.
- The beamline manager is then allowed to remove shielding and exclusion devices as needed.
- If the beamline needs to be opened to an alignment beam, the OOD will post the tag at the vault entrance. The power module shall be disabled and tagged before the next injection.
- When finished, the beamline manager will replace the shielding and exclusion devices and inform the OOD, who will enable the front end power module.

If it is found necessary to remove SRC storage ring or front end shielding or exclusion devices:

- The SRC Operator On Duty is to be informed.
- The OOD shall fill out and post a "Shielding Permit" at the vault entrance.
- The OOD shall post a copy of the "Shielding Permit" and lock-out key at the site of the shielding or exclusion device removal.
- Shielding or exclusion devices can then be removed by SRC authorized personnel.
- When the shielding or exclusion devices has been reinstalled by authorized SRC personnel, the OOD shall verify this, and check-in the "Shielding Permit."

PERMIT FOR WORKING IN RADIATION EXCLUSION ZONE

A one meter exclusion zone is fixed around the Aladdin ring. This exclusion zone is established to prevent personnel from entering an area where radiation, magnetic, and electrical hazards exist. This exclusion zone also prevents any interference with Aladdin ring components or the beam. A magenta and red chain marks the outer perimeter, while the ring cable tray marks the inner perimeter. When beam is present in the ring, personnel shall not enter the exclusion zone unless a permit for working in a radiation exclusion zone is obtained.

- If you need to work inside the exclusion zone, contact the SRC Radiation Safety Manager (RSS).
- The RSS will measure radiation levels and determine if levels are below 20mR/amp of lost

beam in the area in question. If the level is less than 20mR/amp of lost beam, the RSS will issue a permit.

- The original is placed in the “Exclusion Zone Work Permit” folder, while a copy is posted in the work area.
- Personnel working in the area of the Aladdin ring will be trained in the radiation, electrical and magnetic hazards of working in close proximity to the ring.
- The person performing the work will be trained in the use of a radiation detector, and use such detector while working in the exclusion zone. At any time levels exceed acceptable limits, personnel must leave the exclusion zone.
- When work is completed, the permit copy must be returned to the Radiation Safety Manager.

SRC RADIATION SAFETY MANAGER

The SRC Radiation Safety Manager (RSM) is responsible for administering the radiation badge program, including posting radiation badge exposures. The RSM is also responsible for maintaining the Aladdin vault interlock system, radiation shielding and exclusion devices. Radiation levels in the Aladdin building are monitored by the RSM. Questions or concerns regarding radiation should be directed to the SRC Radiation Safety Manager.

LAUE CAMERA

X-ray Radiation

The x-rays generated in an analytical instrument are generated by accelerating electrons from a cathode to an anode (target) in an x-ray tube. Target electrons are knocked out of their orbital shells by the impacting electrons. Electrons from higher energy orbital shells cascade down to the positions previously held by the leaving electrons. The difference in the energy levels of the cascading electron and leaving electron is emitted as electromagnetic radiation, in this case, x-rays.

Biological Effect

Though x-rays do not have as much ionizing potential as alpha particles, their penetration ability may cause ionizations within the body. Exposure to soft x-rays (1-50keV) may result in skin reddening or skin burns. The radiation may also be absorbed in the bones of the extremities. Potential for severe eye damage exists if the eyes are exposed to x-rays.

Use of the Laue Camera

- Only those personnel who have received operational and safety training may use the Laue camera. Cliff Olson provides operational training, while the safety training is provided by the KRC Safety Manager. Upon completion of the training, users may check out the Laue camera HT Lock key, which enables operation of the device.

Safety Devices

- Signs and lights are used to alert personnel to the hazards of the x-ray radiation. "Caution X-ray Radiation" and "Safety Device Not Working"(to be posted when interlocks and/or the exclusion device are bypassed) are to be used to alert personnel. Lockout/Tagout procedures must be followed while conducting repairs or maintenance. Alert lights are activated when the x-ray tube is energized and when the shutter is open.
- Interlocks built into the Laue camera link the collimator/aperture connection with the shutter open button,

the HT Lock key switch with the x-ray tube high voltage supply, and the exclusion device with the x-ray tube high voltage supply. These interlocks will prevent generation of x-rays while safety devices are inactive.

- Radiation shielding and exclusion devices are used to protect personnel from exposure to hazardous radiation levels.

Potential Radiation Exposure

- Possible radiation exposure from direct exposure to the x-ray beam from collimator would result in an exposure in excess of 200 mRem per hour. The actual radiation exposure personnel would receive would be 0 mRem per hour. This would result in little or no impact on personnel operating the Laue camera.

Safe Operation of Laue camera

- No one is allowed to use the Laue camera without special training first. See the Safety Manager to set-up training and check out keys.

Chapter 33. SRC Beamline Optics

SRC Users are not allowed to adjust any optical element in the beamline. Contact the beamline manager if optics need adjusting.

If any vacuum accident occurs, inform the SRC Operator On Duty, the person in charge of your research program, and the beamline manager immediately.

All glass windows in the vacuum system must be mechanically protected whenever they are not directly used.

SRC Users are to avoid blocking access to the main control panel with their equipment. Access to breaker panels and utilities will be maintained at all times.

The beamlines contain reflecting and focusing optics that can significantly concentrate the synchrotron radiation. Users should avoid looking into the beam.

When leaving at the end of the quantum, Users should make sure that the supply valves of the utilities are closed properly.

See Chapter 26, "*Pressurized and Vacuum Operations*" for further rules regarding beamline, optics, and vacuum protection.

Chapter 34. Eating, Drinking, Smoking, Etc.

1. Eating and/or Drinking

Eating and/or drinking is prohibited in any area where hazardous chemicals are present. Hazardous chemicals are used and/or stored in the Aladdin vault, SRC Chemical Room, SRC Cleanroom, SRC Optics Cleanroom, SRC Chemical Storage Building, CNTech Annex, CNTech cleanrooms, PSL High Bay Area, PSL Vacuum Test Area, KRC Flammables Shed, KRC Equipment Storage Building, and the Tomotherapy building vault.

At the SRC, eating and/or drinking is allowed only in designated areas. Designated eating/drinking areas include the main level of the Aladdin Building, the break area on the lower level of the Aladdin Building, office trailers, and the SRC Machine Shop Office.

Wash hands thoroughly after working in areas where laboratory chemicals are present, and before conducting the above activities.

Avoid storage, handling or consumption of food or glassware, or utensils which are also used for laboratory operations.

2. Smoke-Free Policy

Smoking is NOT permitted within buildings on University of Wisconsin property. It is only permitted outside of buildings.

The UW Smoke-Free Policy can be found in the Appendix.

3. Alcohol Policy

Consumption of alcohol beverages on University of Wisconsin lands and buildings is regulated under Wisconsin Administrative Code UWS18.06 (13).

The use or possession of alcohol beverages is prohibited on all University premises, except in faculty and staff housing and as permitted by the Chief Executive Officer, subject to statutory age restrictions. The Chief Executive Officer may generally permit the use or possession of alcohol beverages by promulgating institutional regulations in consultation with appropriate staff, or in specific instances by written permission. This regulation extends to laboratories and individual offices.

A University employee must agree to be present at and supervise any event where alcohol beverages are served.

Alcohol beverages may not be served or consumed in academic, administrative, or research areas during usual business hours.

Chapter 35. Magnetic Fields

1. Policy

To prevent exposure of personnel to hazardous magnetic field levels. Appropriate cautions, training and signs will be used when strong magnetic fields are in operation.

2. Occupational Exposure

The US Department of Energy recommends that exposure to magnetic fields during a time weighted 8 hour average (40 hour work week) not exceed 100 gauss. As a short term exposure limit, 1000 gauss should not be exceeded for periods over one hour.

Levels in excess of 14 gauss may cause problems with cardiac pacemakers, vascular clips and prostheses.

3. Procedures

The magnetic field is to be measured to find its boundaries. Where the levels exceed 5 gauss, signs and barricades should be placed. Use "Magnetic Field Areas-Caution" where levels exceed 5 gauss.

Magnetic field levels of approximately 17 gauss may close the switch in cardiac pacemakers. Place signs and instruct all wearers of pacemakers where magnetic fields exceeding 10 gauss are present.

Computers and computer disks may be affected by magnetic fields present. Protect all sensitive equipment.

In general, metal in a person's body will not become a projectile. However, be aware of magnetic fields present as they do have an effect on pacemakers, vascular clips and prostheses.

Finally, ensure only essential personnel (the responsible experimenters) enter the areas of high magnetic fields.

Further information on safety when working with magnetic fields may be obtained from the UW Safety Department, 9-262-8769.

Chapter 36. Confined Space Operations

1. Policy

The KRC requires compliance with COM 32.28 “Confined Spaces” in addition to 29 CFR 1910.146 “Confined Spaces” to provide maximum protection for personnel to enter and work in confined spaces. All personnel and subcontracted employees are required to follow the confined spaces entry procedure which is extremely important as a means of preventing serious harm or death. An authorized permit system has been designed to minimize risk of accidental injury or death associated with entry or work in confined spaces. Additionally all confined spaces are to be identified. Level one confined spaces exist at the KRC. Spaces include the large water sump located in the SRC Mechanical Equipment Room, the SRC elevator shaft, KRC ventilation ducts, KRC air handling units, and the SRC cooling tower ventilation fan accesses. Confined spaces are identified by a sign indicating a confined space hazard is present.

2. Definitions

Attendant/Work Supervisor- An individual stationed outside a confined space who monitors and performs all Attendant/Work Supervisor's duties assigned in the KRC entry program.

Authorized Entrant- An employee or subcontracted employee who is authorized by KRC to enter a confined space.

Confined space- An environment which by design or construction has limited openings for entry and egress, has unfavorable natural ventilation, could reasonably be believed by KRC to have dangerous air contaminants or contain materials which may produce dangerous air contaminants, and is not intended for continuous occupancy.

Engulfment- The surrounding and effective capture of a person by a liquid or finely divided flowable solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

Entry- The action by which a person's head breaks the plane and passes through an opening into a confined space.

Entry permit and checklist- Documents to be completed and signed by authorized Entrants, Attendant/Work Supervisor, and Confined Space Monitor, prior to entry of a confined space.

Hazardous atmosphere- An atmosphere that may expose personnel to the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness from one or more of the following causes:

Flammable gas, vapor or mist in excess of 10% of its lower explosive limit (LEL)

Airborne combustible dust at a concentration that meets or exceeds its LEL

Atmospheric oxygen concentrations below 19.5% or above 23.5%

Atmospheric concentrations above the permissible exposure limit (PEL)

Any other atmospheric condition that is immediately dangerous to life

Immediately dangerous to life- Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a confined space.

Isolation- A process that removes the confined space from service and is completely protected against the inadvertent release of material. This is accomplished through lockout/tag-out procedures.

Level One confined space- A confined space that does not contain or with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious harm.

Lower explosive limit (LEL)- The minimum concentration of a combustible gas or vapor in air which will ignite if an ignition source is present.

Purging- The displacement of gases, vapors, airborne contaminants, liquids, and solids from a confined space.

3. Responsibilities

Entrants are responsible for;

- Reporting to the KRC Safety Specialist any confined space not identified as such prior to entering the space.
- Wearing appropriate personal protective equipment,
- Completing the Confined Spaces Entry training program,
- Ensuring an authorized “Confined Spaces Entry” checklist and permit have been completed prior to entering a confined space.
- Following safe procedures for working in a confined space.

Attendant/Work Supervisor is responsible for:

- Remaining at the entrance to the confined space at all times during operations.
- Maintaining an accurate count of all personnel in the confined space.
- Monitoring all activities inside and outside the space to determine if it is safe for the occupants to remain in the confined space.
- Maintaining effective communications with the personnel in the confined space.
- Completing the Confined Spaces Entry training program.
- Ensuring an authorized “Confined Spaces Entry” checklist and permit have been completed prior to entering a confined space.

Confined Space Monitor is responsible for:

- Informing KRC personnel of KRC's Confined Spaces program and ensuring they are trained and implement the requirements and procedures needed to work in confined spaces.
- Inspection of the work area to evaluate the hazard potential.
- Testing the confined space for flammable, explosive, toxic, and/or oxygen deficient atmospheres and ensuring air quality is acceptable prior to entry.
- Preparing and maintaining safe work conditions while work is performed in the confined space.
- Ensuring an authorized “Confined Spaces Entry” checklist and permit are completed and posted at the confined space prior to entry.
- Ensuring KRC personnel complete the Confined Spaces Entry training program if confined space entry is a requirement of their job.

The KRC Safety Specialist is responsible for:

- Providing Confined Spaces Entry training to applicable personnel.
- Assisting personnel in identifying potential confined spaces and the hazards that may be encountered (including air quality monitoring).

- Recommending engineering and personal protective equipment required to perform the work safely.

4. Training

All personnel who will be required to work in a confined space and supervisors who will be responsible for approving confined space entries must complete a Confined Space Entry training program. Specialized training will be required for those assigned to use air quality monitoring instrumentation. Only personnel who have received respiratory protection training are authorized to use respiratory protection equipment. Records of Respiratory Protection and Confined Space training are maintained by the KRC Safety Specialist.

5. Procedures

Obtain “Confined Space Entry Permit” and “Confined Space Entry” checklist-All confined space entries will be by authorized permit only. The permit will authorize trained personnel to enter confined spaces safely. The trained supervisor of the personnel performing the work or the KRC Safety Specialist will be authorized to complete the permit and ensure all hazards are identified and the necessary safety precautions completed to allow work to be conducted safely in the confined space. The active permit will be posted at the entrance of the confined space and submitted to the KRC Safety Specialist upon completion of the job. The checklist is used by the Confined Space Monitor as a guide to the procedures to follow during confined space entry. All personnel involved in the confined space work are to be involved in completing the “Confined Space Entry” checklist.

Hazard Identification and Control-All hazards involved in entering and working in confined spaces are to be identified, documented in the “Confined Space Entry Permit”, and controlled prior to entry. Generally, a confined space hazard is the result of hazardous air quality or physical hazards that are present. Purging of the contents of the confined space, lockout and tag-out of all sources of power, isolating the confined space from release of materials into it, and ventilating the confined space are necessary means of control.

Air Monitoring-Air quality in all confined spaces must be tested prior to entry and while work is being performed in a confined space. The following are acceptable air quality levels (per 29 CFR 1910.146): an oxygen concentration greater than 19.5% and less than 23.5%; a hydrogen sulfide concentration of no greater than 10ppm; carbon monoxide concentration of no greater than 35ppm; a combustible gas concentration of no greater than 10% of the LEL; and any other hazardous substances which the employee is expected to work with have a concentration no greater than the PEL. It is important to test all areas of the confined space due to the different densities of gases. If testing reveals unacceptable air quality, the space will be mechanically ventilated and retested before workers may enter. An air monitoring device is available from the UW Safety Department. It is to be calibrated prior to use at a reasonable distance from the confined space.

Verify Checklist and Permit-Ensure that the “Confined Space Entry Permit” has been completed and posted near the confined space prior to entry. Verify that all items on the “Confined Space Entry” checklist have been completed. Entry to a confined space is permitted only after the permit and checklist have been completed.

Inside The Confined Space-Many times work inside confined spaces requires the use of personal protective equipment such as gloves or respiratory protection. Selection of personal protective equipment will be based on the hazard evaluation and specified on the permit. Air-purifying respirators shall not be used in an oxygen deficient atmosphere. Specialized equipment for the confined space's conditions should be used when appropriate. This includes spark-proof tools or explosion proof equipment. At all times maintain contact with the Attendant/Work Supervisor. Use portable communications equipment if necessary. From reading the permit and applicable Material Safety Data Sheets, entrants should be aware of signs of exposure to a hazardous atmosphere. Entrants and the Attendant/Work Supervisor are also to be prepared to initiate emergency procedures. At no time may an Attendant/Work Supervisor enter a confined space except during emergency, and then only if air quality or physical hazards will not put the Attendant/Work Supervisor at risk.

Continuous Air Monitoring-Maintain air quality monitoring throughout the time personnel are in a confined space. Unacceptable air quality at any time during work shall require an immediate evacuation of the confined space.

6. Emergency Procedures

All contingencies for emergencies in the confined space will be evaluated by the facility safety officer and the necessary equipment readily available to handle the possible emergency will be obtained. All rescue and/or emergencies for confined space operations will be initiated by dialing 911 and notifying the dispatcher of the nature of the emergency. Only the Stoughton Fire Department and/or the Madison Hazardous Materials Team are authorized and trained for making rescues from confined spaces. KRC personnel may not enter a confined space to attempt a rescue under any circumstances when a hazardous atmosphere or physical hazard is present.

Upon an emergency within a confined space, follow these steps for rescue:

- Immediately shout or call for help. Do not enter the confined space if a hazardous atmosphere or physical hazard is present.
- Call 911. Inform the emergency dispatcher of the situation.
- If the confined space is safe to enter, based upon air quality monitoring and employee judgment, then do so to provide first aid until professional help arrives. The confined space Attendant shall not leave the confined space entrance. Other personnel should direct professional help to the scene.
- After professional help arrives, assist if requested to do so.

Chapter 37. Fall Protection

1. Policy

The OSHA “Fall Protection Standard for the Construction Industry” (29 CFR 1926.500, 1926.501, 1926.502, and 1926.503), known as Subpart M, regulates fall protection for construction work performed within the private sector. The Wisconsin Department of Commerce has adopted Subpart M to apply to construction activities within the public sector (COM 32.50). Examples of activities covered under this interpretation would be facility construction or major renovation. DOC will enforce this standard by use of Wisconsin State Statute, Section 101.1(1)(2) “Safe Workplace Statute”. Nonconstruction activities and general maintenance, are covered under COM 32.22 which also incorporates 29 CFR 1910.25 and 1910.26. These are general standards for occupational safety using ladders.

Injuries from falls are a leading occupational injury. It is the intent of the Kegonsa Research Campus to provide maximum protection to its staff in the prevention of falls. Known fall hazards will be identified, inspected and fall protection provided to ensure the safety of personnel. Engineering controls, administrative procedures and the use of personal protective equipment will be utilized. The “Fall Protection Standard” must be followed where personnel can possibly fall six feet or more, but does not apply "when personnel are making an inspection, investigation, or assessment of workplace conditions prior to the actual start of construction work or after all construction work has been completed". This exemption does not apply when inspections are carried out two feet or less from an unprotected edge. Under OSHA's interpretation, work conducted within six feet of an unprotected edge (i.e. roof line) must comply with the “Fall Protection Standard”.

Ladders under twenty feet are exempted from the OSHA “Fall Protection Standard”.

Training will be provided to personnel in the identification of fall hazards, safe work practices, and selection, use, inspection, and maintenance of personal protective equipment.

2. KRC Fall Hazards

The KRC is inspected for fall hazards. The KRC engineering staff, KRC Safety Specialist, and the facility safety officers will evaluate each potential fall hazard. Engineering controls (handrails, etc.) will be constructed where possible, and safe work practices and personal protective equipment will be used. Fall hazards include, but are not limited to, unprotected sides and edges of roofs, excavations, overhead construction and maintenance, roof work, floor holes, wall openings, and all other walking or working surfaces where personnel can possibly fall six feet or more to a lower level. At KRC fall hazards specifically include work on KRC building roofs, transferring materials through the floor opening of the SRC air handling room, maintenance work conducted where a fall of six feet or more from the floor is possible (this does not apply to work on scaffolds or ladders), including work on the Aladdin vault or PSL overhead cranes, lighting, or rafters. Protection from falling hazards must be provided. The placement of toe boards and the use of hard hats will be strictly enforced. Equipment is not to be stored within four feet of an unprotected edge.

3. Engineering Controls

The first step in minimizing work hazards is to determine if engineering controls can eliminate or lessen the hazard of the job. Engineering controls of fall hazards consist of guardrails, toe boards, covers, and other rails or barriers that prevent falls. The KRC will provide engineering controls where possible to minimize fall hazards. Personnel should alert the KRC Safety Specialist to potential fall hazards not already identified and controlled. Additionally anchor points (if necessary) will be installed at locations where personal fall arrest systems (PFAS) will be used.

4. Administrative Procedures (Work Practices)

In all cases, safe work practices are to be followed where potential for a fall exists. Evaluate the work and potential hazards. Prepare for hazards. Contact KRC engineering staff or the KRC Safety Specialist for implementation of engineering controls. Personnel are to work in pairs at all times while conducting work where a potential for a fall exists. All work conducted within six feet of an unprotected edge where a fall exists must wear fall protection equipment. Only properly maintained and inspected equipment is to be used for fall protection. Equipment is to be in compliance with the OSHA “Fall Protection Standard”. Workers are to inspect all equipment before use; if any equipment exhibits signs of wear, it is to immediately be removed from service. Equipment is to be maintained, and stored where it will not be subject to wear. In case of emergency, follow KRC Emergency Procedures.

If a body harnesses must be worn: lanyard attached to harness securely with locking snap hook, lifeline (if used) attached securely to lanyard, deceleration device attached correctly and securely to lifeline and lanyard, and lifeline or lanyard must be securely connected, by locking snap hook, to the anchor point before any work is to be conducted. Inspections are exempted from this requirement per OSHA guidelines. However fall protection equipment is required when inspections occur two feet or less from an unprotected edge or side.

Inclement weather, including but not limited to snow, ice, high winds or rain, pose even greater hazards during work where a potential for a fall exists, i.e. roof work. Personnel are to take additional precautions during such weather. Personnel should contact their supervisor to review additional precautions before beginning affected work. Work should not be conducted on roofs during lightning storms.

5. Personal Protective Equipment

The use of personal protective equipment to minimize fall hazards will be strictly enforced. The optimal solution is to use engineering controls, but if engineering controls do not eliminate the hazard, work practices and personal protective equipment must be used. The use of personal fall arrest systems (PFAS) are the allowed personal protective equipment for fall hazards at the KRC. A PFAS consists of a full-body harness, lanyard, and anchor point. A second option is to use a full-body harness, lanyard, lifeline, anchor point, and deceleration (grabbing) device. Only full-body harnesses are to be used, the use of a body belt is prohibited. Non-locking snap hooks are unacceptable for personal fall arrest systems.

Requirements (from 29 CFR 1926.502) of a personal fall arrest system (PFAS) include:

- D-rings and snap hooks are to have a minimum tensile strength of 5000 pounds. A proof test of 3600 pounds is required.
- Lanyards and lifelines are to have a minimum breaking strength of 5000 pounds.
- Lanyards are not to exceed six feet in length.
- Self-retracting lifelines and lanyards are to have a strength of at least 3000 pounds and limit free fall to two feet or less.
- Anchor points for fall arrest systems are to be capable of supporting at least 5000 pounds per employee when the system is designed, installed (temporarily or permanently), and used under the supervision of a qualified person.
- Personal fall arrest systems are to limit the maximum arresting forces to 1800 pounds with a full body harness.
- The maximum free fall distance is six feet for systems.
- The maximum deceleration distance is 3.5 feet.
- Personal fall arrest systems are to have sufficient strength to withstand twice the potential impact energy of the falling employee.
- Impacted components are to be removed from service.
- Prompt rescue must be provided for personnel who have fallen.
- Personal fall arrest systems are to be inspected prior to each use.
- Lifelines subject to cutting or abrasion are to be a minimum of 7/8 inch wire core manila rope. All other lifeline applications are to use a minimum of 3/4 inch manila rope or its equivalent.

Fall protection equipment may be checked out from the SRC safety cabinet, from the KRC Safety Specialist, or from the facility safety officer.

Any other personal protective equipment deemed necessary for the task under the “Personal Protective Equipment Standard” is to be worn. This includes but is not limited to hardhats, gloves, safety glasses, and steel toed boots. Please refer to Chapter 9, *“Personal Protective Apparel and Equipment”*. Hard hats must be worn within an area beneath elevated work where objects could fall from a height and strike a worker.

6. Equipment Inspections

Equipment inspections will be conducted by personnel prior to use. If, upon inspection, a piece of equipment shows any of the following signs of wear it must immediately be removed from service. Consult an approved state vendor for intensive maintenance or inspection of equipment.

- Cuts or frayed edges
- Abrasions
- Mildew or mold
- Undue stretching
- Chemical burns
- Dryness
- Corrosion or charring
- Broken stitches
- Inner fiber fuzziness
- Rivets that are loose or distorted

- Substances that have penetrated and hardened in the fibers
- Deformed thimbles or enlarged buckle tongue holes or grommets
- Damaged or distorted snap hooks or faulty springs
- Cracks or distortions in fall protection hardware

7. Training

Training in fall protection is to be obtained prior to working where potential for a fall exists. This training will be conducted annually by the KRC Safety Specialist or a Wisconsin Bureau of State Risk Management authorized training resource. Training will consist of learning to identify fall hazards, minimize fall hazards, and the function, use, inspection, and maintenance of personal fall arrest systems (PFAS) and other restraint equipment. Trainees will also be taught how to identify and inspect anchor points, substantial members of the building structure, or securely rigged lines, which will safely suspend the worker in case of fall. Only attendees of the fall hazard training classes will be allowed to conduct work where potential for a fall exists. Records of attendance will be maintained by the KRC Safety Specialist.

8. Definitions

Anchor point- A secure point of attachment for lifelines, lanyards or deceleration (grabbing) devices.

Body belt- A strap with means both for securing it about the waist and for attaching it to a lanyard, lifeline, or deceleration (grabbing) device. Body belts are prohibited at the KRC.

Body harness- An interconnected set of straps that may be secured about a person in a manner that distributes the fall arrest forces over at least the thighs, pelvis, waist, chest, and shoulders with a means for attaching the harness to other components of a personal fall arrest system.

Connector- A device that is used to connect parts of a personal fall arrest system together (i.e. D-rings, and snap hooks).

Deceleration device- Any mechanism, such as a rope, grabbing device, ripstitch lanyard, specially woven lanyard or automatic self-retracting lifeline/lanyard, which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limits the energy imposed on an employee during fall arrest.

Deceleration distance- The additional vertical distance a falling person travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which a deceleration device begins to operate.

Guard rail- A barrier erected to prevent personnel from falling to lower levels.

Hole- A void or gap in a floor, roof, or other walking/working surface.

Lanyard- Flexible line of rope or strap that generally has a connector at each end for connecting the body harness to a deceleration device, lifeline or anchor point.

Lifeline- A component consisting of a flexible line for connection to an anchor point at one end to hang vertically and that serves as a means for connecting other components of a personal fall arrest system to the anchor point.

Opening- A gap or void in a wall or partition through which personnel can fall to a lower level.

Personal fall arrest system (PFAS)- A system including but not limited to an anchor point, connectors, and a body harness used to arrest a worker in a fall from a working level.

Rope grab (grabbing device)- A deceleration device that travels on a lifeline and automatically, by friction, engages the lifeline and locks to arrest a fall.

Self-retracting lifeline/lanyard- A deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under minimal tension during normal movement and which, after onset of a fall, automatically locks the drum and arrests the fall (usually within two feet or less).

Snap hook- A connector consisting of a hook-shaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released automatically closes to retain the object. Only locking snap hooks are permitted at KRC.

Toe board- A low protective barrier that prevents material and equipment from falling to lower levels and which protects personnel from falling.

Unprotected sides and edges- Any side or edge of a walking/working surface where there is no wall or guardrail system at least 1 meter high (i.e. roof lines).

Walking/working surface- Any surface, whether horizontal or vertical, on which personnel walk or work, including but not limited to floors, roofs, or ramps. It does not include ladders or vehicles on which personnel must be located to perform their work duties.

Chapter 38. Hazardous Material Transportation

1. Policy

The Kegonsa Research Campus will comply with US Department of Transportation regulations concerning transportation of hazardous materials, US Environmental Protection Agency regulations regarding hazardous material spills, and University of Wisconsin policies regarding transportation of hazardous materials. KRC will ensure its personnel responsible for shipping, receiving, or transporting hazardous materials are properly trained to comply with US DOT regulations and handle hazardous materials safely.

The Hazardous Material Transportation policy only pertains to shipping or receiving hazardous materials by motor vehicle and transportation of hazardous materials by motor vehicle. The majority of shipping and receiving is done by non-bulk packaging. The liquid nitrogen supplied to KRC is transported by bulk packaging.

2. Definitions

Bulk packaging- For this safety manual, packaging in excess of 119 gallons for liquids, mass greater than 882 pounds for solids, or water capacity greater than 1000 pounds for gases.

Examples of bulk packaging include tank cars or portable tanks.

Consumer commodity- Material that is packaged and distributed in a form intended or suitable for retail sale. A consumer commodity must also be a limited quantity.

Gross weight- Total weight of hazardous material and its packaging.

Hazard class- Category of hazard assigned to a hazardous material. It is symbolized by a number, color and unique label design. The hazard class of each hazardous material must be written and labeled on each package, and indicated on shipping papers.

Hazardous material- A substance or material determined by the DOT to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce. DOT includes EPA hazardous substances [when above its Reportable Quantity] in its definition of hazardous material even though DOT does not specifically include each EPA hazardous substance in its list of hazardous materials.

Hazardous substance- For DOT, an EPA hazardous substance equal to or exceeding its Reportable Quantity. Below its RQ, DOT does not consider it to be a DOT hazardous substance.

Hazardous waste- Material subject to the Hazardous Waste Manifest Requirements of the EPA. A waste is a material that is no longer usable and has hazardous characteristics of flammability, corrosivity, reactivity, or toxicity.

Limited quantity- When specified in sections applicable to a particular material, it means the maximum amount of a hazardous material for which there is a labeling or packaging exception.

Marking- Descriptive name, UN number, instructions, cautions, weights, specifications, and UN mark required by DOT on outer packaging of hazardous materials.

Material of trade- Hazardous material, other than a hazardous waste, that is carried on a motor vehicle: for purposes of protecting the health and safety of the driver and passengers; for supporting the operation or maintenance of a motor vehicle; in direct support of a business that is other than transportation.

Non-bulk packaging- Hazardous material packaging with a maximum capacity of 119 gallons for liquids, a maximum weight of 882 pounds for solids, or a water capacity less than 1000 pounds for gases.

N.O.S.- Not otherwise specified. Used when a material is classified as a hazardous material but its shipping name is not specific. For example, Rust-oleum aerosol spray paint's proper shipping name would be Compressed gas, flammable, n.o.s.

Outer packaging- Outermost enclosure of packaging together with any absorbent material, cushioning and any other material necessary to contain and protect the inner packaging.

Packing group- Grouping according to the degree of danger presented by hazardous materials. Packing group I indicates great danger; Packing Group II indicates medium danger; Packing Group III indicates minor danger.

Placard- Large diamond shaped symbols indicating the hazard class of each hazardous material contained in a motor vehicle. Placards are required on motor vehicles for any amount of explosive, poison gas, dangerous when wet, organic peroxide, poison inhalation hazard or radioactive material. For other hazard classes, a maximum weight of 1001 pounds of a hazardous material may be transported without placard.

Primary hazard- The most dangerous hazard of a specific hazardous material determined by the DOT.

Residue- Hazardous material remaining in a package after its contents have been unloaded to the extent normally conducted. Residues are still regulated by DOT as a hazardous material. If the package is cleaned and no residue remains, the package is no longer regulated by DOT.

Shipping manifest- Specific type of shipping paper used for shipping hazardous waste.

Shipping name- Name of the hazardous material, as determined by the DOT, for purposes of shipping.

Shipping paper- Shipping document containing the information required by the DOT. This document must include for each hazardous material the shipping name, hazard class, UN number, Packing Group, weight or volume, shipper's address, signature of the shipper, and an emergency contact phone number.

Subsidiary hazard- The secondary hazard of a specific hazardous material determined by the DOT.

UN number- Universal United Nations identification number specific to a hazardous material.

UN standard packaging- Packaging conforming to the standards in the UN Recommendations on the Transport of Dangerous Goods. All hazardous materials must be shipped in UN standard packaging. A UN code is stamped on the packaging.

3. Receiving

Incoming hazardous materials arrive at the KRC Receiving Department. Most incoming hazardous material shipments arrive by commercial carrier. Radioactive materials will arrive from the UW via its Safety Department. Personnel who have received Basic Hazardous Material Training may receive or open hazardous material shipments. Hazardous materials may always be identified from the shipping paper or marking on the package. Prior to accepting the package, verify that the shipping paper matches the information on the package. Examine the package for damage or leakage. Do not accept a leaking or damaged package. When opening the package, any leakage should be treated as hazardous. See Chapter 13 "*Spills and Accidents*" for hazardous material spill procedures. Notify the KRC Safety Specialist of all hazardous material spills.

All hazardous materials used or stored at the KRC must have an MSDS. Contact the KRC Safety Specialist if an MSDS was not provided with the shipment.

4. Shipping

All outgoing hazardous materials are shipped out through the KRC Receiving Department. Most outgoing hazardous material shipments are sent by commercial carrier, for example UPS. Surplus or waste chemicals are transported to campus by the UW Safety Department.

Only personnel who have received Function Specific Hazardous Material Training may package, prepare shipping documents, or arrange for transportation of hazardous materials.

Complete shipping papers, highlighting hazardous materials. Prepare the material in appropriate packaging. If the hazardous material's container could be damaged resulting in spillage of the hazardous material, use outer packaging surrounding the inner packaging. Ensure that the material shall not leak or spill out of its package. Mark the package with the appropriate hazardous material information and label the package. Verify that the hazardous material has been logged into the Chemtel emergency response registry. Contact the UW Safety Department for verification.

The shipping paper must be completed properly with the correct shipping name, hazard class, UN number, Packing Group, weight or volume, shipper's address, signature of the shipper, and emergency contact phone number. The package must be marked with the appropriate shipping name, UN number, instructions, cautions, weights, specifications, and UN mark required by DOT on outer packaging of hazardous materials. The package must also be labeled with its primary hazard and [if applicable] subsidiary hazard.

5. Transporting Between KRC and Campus

Personnel may transport hazardous materials between campus and KRC. KRC surplus or waste chemicals are transported by the UW Safety Department to campus. Placarding of vehicles is unnecessary unless placardable quantities are transported. For all quantities greater than 30mL** shipping papers must be prepared, and proper marking and packaging must be done. An MSDS for each hazardous material transported by KRC driver is to be present in the vehicle while transporting the material. Contact the KRC Safety Specialist or the KRC Receiving Department for assistance.

** Radioactive, explosive, poisonous liquids or gases, or dangerous when wet materials require shipping papers, proper marking and packaging and placarding for any quantity. The UW Safety Department must be used for transporting radioactives and explosives. The UW Safety Department should be used for transporting dangerous when wet materials or poisonous liquids or gases. Consumer commodities do not require shipping papers or marking.

Staff and Users are discouraged from using private vehicles to transport hazardous materials. The UW Safety Department can provide transportation of hazardous materials from campus to the KRC. Contact the KRC Safety Specialist.

Empty barrels are to have any hazardous residue removed, be rinsed completely, and marking removed before transporting to campus. If any residue is within the barrel, the barrel is considered a hazardous material. Unwanted batteries may be considered hazardous materials. Before shipping batteries to campus for recycling, contact the KRC Safety Specialist, read Chapter 16 “*Waste Disposal Program*”, or the *Appendix “KRC Waste Disposal and Recycling Table”* for proper procedures. Some batteries may simply be thrown in the trash. Ensure gas cylinders and cryogenic liquid dewars are secure and will not shift during driving or braking.

Chemical goggles and appropriate gloves should be carried on the vehicle when transporting hazardous materials. The *North American Emergency Response Guidebook* is to be carried by the driver of any vehicle transporting hazardous materials.

Materials of trade, for example, auto supplies carried on the KRC van for repairs, are exempt from DOT regulations.

6. Training

All personnel involved in receiving hazardous material shipments will receive Basic Hazardous Material Training which will cover identification of hazardous material packages, hazardous material receiving procedures, and emergency procedures. This training is provided at least once each three years. Training will be coordinated by the KRC Safety Specialist.

Those personnel involved in shipping hazardous materials are to receive in addition to the Basic Hazardous Material Training, Function Specific Hazardous Material Training. FSHMT certifies personnel to ship hazardous materials. This course goes into detail on shipping papers, marking of packages, labeling of packages, placarding vehicles, and regulations affecting the shipment of hazardous materials. This training is provided at least once each three years. BHMT is to be done in addition to FSHMT.

KRC personnel who transport hazardous materials to or from the Kegonsa Research Campus will receive driver safety training, including proper emergency response.

7. Emergency Procedures

If a package leaks or hazardous material spills during transport, KRC employees should not attempt to deliver the hazardous material. Do not remain on the road or continue to drive. Pull over to the side of the road and evaluate the situation. Evacuate the vehicle and call 911 if the spill is immediately hazardous to life. Do not attempt to contain or treat a spill that could be immediately hazardous to human life. If the spill is not immediately hazardous the driver may attempt to deal with the spill. The spill should be contained if able to do so safely. Follow the procedures for dealing with chemical spills in Chapter 13 “*Spills and Accidents*” and/or the procedures described in the *North American Emergency Response Guidebook*. Notify the KRC Safety Specialist of all hazardous material spills.

Chapter 39. Hearing Protection Plan

1. Policy

The Kegonsa Research Campus hearing protection plan has been established to protect staff and Users of the KRC from exposure to hazardous levels of occupational noise. This hearing protection plan complies with Wisconsin COM 32 “Public Employee Safety and Health”. This section of COM 32 incorporates by reference the OSHA “Hearing Conservation Standard”, 29CFR 1910.95. Implementation of an OSHA Hearing Conservation Program is required when an employee noise exposure exceeds 85 dBA for an 8 hour time weighted average. The OSHA “Hearing Conservation Standard” requires noise monitoring and when employees are exposed to noise levels equal to or greater than 85 dBA for an 8 hour TWA requires audiograms, access to hearing protection, and training.

2. Responsibilities

Supervisors are to ensure that employees under their direction are protected from exposure to hazardous levels of occupational noise. Supervisors should consult with facility safety officers and the KRC Safety Specialist to evaluate potential noise hazards. The KRC will reduce the noise hazard by engineering controls and/or provide hearing protection to the affected persons. Supervisors are responsible for compliance with the Hearing Protection Plan within work areas under their control.

The KRC Safety Specialist is responsible for:

- Identifying potentially hazardous noise exposures and coordinating exposure measurement
- Ensuring facility safety officers and supervisors are aware of potential noise hazards
- Identifying affected employees
- Identifying and implementing exposure-reducing actions
- Training affected employees
- Obtaining annual audiometric tests for all affected employees
- Noise exposure, audiometric and any other applicable records
- Evaluation of the effectiveness and completeness of the Hearing Protection Plan.

Supervisors and facility safety officers are responsible for

- Compliance with the Hearing Protection Plan within work areas under their control.
- Identifying potentially hazardous noise exposures to the KRC Safety Specialist

KRC staff and Users are responsible for:

- Identifying potentially hazardous noise exposures to their supervisor, facility safety officer or the KRC Safety Specialist
- Using the appropriate hearing protection

3. Noise Measurement/Employee Monitoring

Regular instrumental measurement of noise levels is not usually practiced in the KRC, but is appropriate when testing or redesigning equipment that could pose a noise hazard. The UW Safety Department may be called in for noise measurement when needed.

Inclusion of employees in the Hearing Protection Plan is mandatory whenever personal dosimetry or other sound level measurements indicate that employee exposure equals or exceeds 85 dBA (as an 8 hour TWA). Inclusion is also mandatory whenever employees are exposed to any impulsive or impact noise with peak sound levels equal or exceeding 140 dBA.

Sound level meters may be used to determine areas or tasks that have a potential for hazardous noise levels. Areas or tasks that register 85 dBA or greater will have personal dosimetry conducted.

Employees will have the opportunity to observe noise measurement collection in a manner that does not disrupt workflow. Employees are entitled to receive a copy of noise measurements collected within their work area(s) at no cost to the employee.

4. Audiograms

Audiometric examinations will be conducted by a qualified audiologist. The audiometric examination provider will administer and review all audiograms and will refer employees with questionable findings to the KRC Safety Specialist.

All employees regularly exposed to hazardous noise levels and requiring participation in a OSHA Hearing Conservation Program will be provided with audiometric examinations within the first 180 days following the implementation of KRC's Hearing Protection Plan. This examination will be at no cost to the employee and the employee will be provided a copy of the examination record upon request. Every twelve months after the initial assessment, the employee is to be provided with an annual audiometric examination. Annual exams will stop if workplace noise measurement data indicates that continued coverage under the Hearing Protection Plan is no longer necessary, at which time a final audiometric exam is to be provided. Exposure to noise must be minimized for 14 hours prior to all audiometric exams.

If a standard threshold shift (average shift in either ear of 10 dB or more at 2000, 3000, and 4000 Hertz) is identified by the audiologist:

The employee will be re-tested within 30 days to verify the finding.

The employee will be notified in writing of the threshold shift within 21 calendar days of verification of the finding.

The employee will be informed of the need for further evaluation if a medical problem is suspected.

The use of hearing protection will be mandatory, and will be enforced by the employees's supervisor, facility safety officer and KRC Safety Specialist.

The employee will be refitted or retrained in the use of hearing protection.

Hearing Protection

Hearing protection will be readily available to all employees exposed to noise levels equal to or greater than 85 dBA (8 hour TWA). Hearing protection will be provided at no cost to employees. Earplugs are available in boxes distributed in areas where noise levels may be hazardous and in the KRC Stockroom. Earmuffs may be obtained from supervisors or the KRC

Safety Specialist. Signs will be posted in areas where hearing protection is recommended and where hearing protection is required.

Use of hearing protection is mandatory for all employees exposed to noise levels equal to or greater than 90 dBA (8 hour TWA). Employees exposed to noise levels between 85 dBA and 90dBA should wear hearing protection.

Any employee exposed to noise levels equal to or greater than 85 dBA (8 hour TWA) who has not had an initial audiometric exam shall be required to wear hearing protection until an initial audiometric exam is obtained. Any employee exposed to noise levels equal to or greater than 85 dBA (8 hour TWA) who has experienced a standard threshold shift shall be required to wear hearing protection while present within areas with sound levels exceeding 85 dBA.

5. Training

Annual training for affected staff and Users will be conducted by the KRC Safety Specialist, and will include information on:

- The effects of noise on hearing.
- Hearing loss symptoms.
- The purpose and proper use of hearing protectors, the advantages and disadvantages of various types.
- Instructions in the selection, fitting, use and care of hearing protectors.
- The purpose of audiometric testing and an explanation of the test procedures.

6. Record Keeping

Copies of all records required under this program shall be retained by the KRC Safety Specialist. Noise measurement, exposure records, and audiometric test records will be retained for the duration of the affected workers employment plus thirty years. Individual employee records shall be provided to the employee at their request.

7. Tasks With Potentially Hazardous Noise Levels

The tasks listed below may pose a risk of exposure to hazardous noise levels. Contact the KRC Safety Specialist, the facility safety officer, or your supervisor to determine if hearing protection must, or recommended, be worn.

- Operating a lawn tractor or any powered lawn maintenance equipment
- Operating powered snow removal equipment
- Operating a forklift or any other heavy mechanical equipment
- Working in the SRC Air Handling Room or SRC Mechanical Equipment Room

8. Definitions

Audiogram-Measurement of one's hearing ability. Hearing loss may be determined from the test results.

Decibel-Logarithmic unit of sound measurement used in expressing sound levels.

Earmuff- A device placed over one's ears to reduce noise. The cups fitted over each ear contains noise absorbing material.

Earplug- Disposable foam device inserted into one's ear canal to reduce noise.

Noise Reduction Rating-Rating given to hearing protection (earmuffs, earplugs) to show their effectiveness in reducing noise.

Threshold shift-Permanent or temporary impairment of one's ability to hear [typically] higher frequencies.

Chapter 40. SRC Working Alone / Two Person Rule

To minimize the risk of injury to staff and users, the following policy/rule has been established to identify specific tasks which require two persons to be present in order to perform these tasks. (Being present means within audible or visual range.) The second person must be someone who can provide appropriate assistance in the event of an emergency (e.g. call for help). Normal operating hours, as referred to in this policy, shall be identified as anytime there is an assigned operator or security guard on duty.

1. General Rules, After Normal Hours, Administrative Work, and Additional Tasks:

SRC shall have two-way radios available which, when activated, will call an emergency phone number. These radios will be located on the radiation dosimeter (badge) distribution desk, which is located at the bottom of the main stairway of the SRC building. Any time staff and/or users are working alone, or they recognize that they are working alone, in the lower level of SRC (Experiment Preparation Area, Vault, Machine Shop, Annex, etc.) or the balcony/air handling room it is their responsibility to obtain a two-way radio and keep it on their person until they leave the facility. Upon leaving, the two-way radio should be returned to its charger cradle.

The two-way radios are connected to the outside phone lines through a telephone auto-dial interconnect. The Emergency System Is Activated By Pushing the Transmit (Talk) Button and Either Of The Two Red Buttons On The Two-Way Radio (See Diagram Posted At The Desk). When the two buttons are pushed, the radio is connected to the telephone auto-dial interconnect, which will automatically connect its user to the UW-Madison Police and Security Dispatcher. (It may take up to 15 seconds for the call to go through, due to the switching processes.) When the dispatcher answers, he or she will attempt to speak to the person in possession of the two-way radio. *(When the dispatcher answers, be certain to always tell him or her that your call is an emergency, if you are able! In the event that you may activate the emergency system accidentally, please stay on the line and tell the dispatcher that this was an error!)* To talk to the dispatcher, the radio user must push the transmit button on the two-way radio. To listen, the transmit button must be released. If the person using the two-way radio fails to respond, the dispatcher will immediately notify the local emergency response agency.

Also, outside of normal hours, all personnel working in the SRC lower level or the balcony/air handling room must sign-in on a sign-in sheet located at the radiation dosimeter distribution desk, which is located at the bottom of the main stairway of the SRC building. When signing-in, staff and/or users must state the location within the SRC lower level or balcony/air handling room where they intend to be working, and then sign-out when they leave these areas. A zone map listing the areas of the SRC lower level and the balcony/air handling room will be available at the sign-in sheet. When signing-out, please be aware of how many others are still signed-in. If there is only one person that remains signed-in, your leaving means this person will now be working alone. When this occurs, please locate or page that person before you leave and notify them that they will now be working alone.

If there is someone already signed in when you enter the vault and there is a two-way radio missing from its charger cradle, it is likely that you are not alone in the area that requires signing-in. However, if you are working in a zone distant from the zone that the person designated or if you do not see them present, it would be prudent to take one of the extra two-way radios for added safety. If you are leaving the area that requires sign-in for a brief period of time, please return the two-way radio to its charger cradle until you return. It is not necessary to sign-out (and then sign back in) when leaving for a brief period of time.

Administrative work conducted in the offices located on the upper floor of the SRC building, and in the trailers located on the KRC Campus, is exempt from the two-way radio requirement and the two-person rule.

2. Overhead Crane Lifting Operations (*KRC Safety and Procedures Manual* page 24-5):

- a. An experienced overhead crane operator may perform lifts which are less than or equal to five feet six inches high (the 4 meter NIM platform height) and/or less than 300 pounds (the weight of a turbo pump). Overhead crane operations which require lifts to exceed these heights and/or weights require two persons.
- b. Two persons shall be required to perform high consequence lifts, defined as lifts which create or present a risk to personnel and/or create or present the risk of collateral damage.
- c. For inexperienced overhead crane operators, two persons shall be required to perform all lifts.

3. Entering Confined Spaces (*KRC Safety and Procedures Manual* page 36-1):

Confined Spaces and Permit-Required Confined Spaces rules shall apply to all confined space entries. An authorized permit system exists at KRC in order to minimize the risk of accidental injury or death associated with entry or work in confined spaces. A minimum of three persons are required for any confined spaces work.

A confined space is a space that:

Is large enough and so configured that an employee can bodily enter and perform assigned work, and
Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry), and is not designed for continuous employee occupancy.

A permit-required confined space means a confined space that has one or more of the following characteristics:

Contains or has a potential to contain a hazardous atmosphere.

Contains a material that has the potential for engulfing an entrant.

Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section. Or, Contains any other recognized serious safety or health hazard.

4. Electrical Work (*KRC Safety and Procedures Manual* pages 23-3 and 17-4):

Lockout / Tagout rules shall apply to all electrical work. With the exception of item b listed below, only one person is required to perform electrical work when lockout/tagout rules are followed.

a. Lockout/Tagout is implemented to safeguard personnel while performing servicing or maintenance on machines and equipment where unexpected start-up or release of stored energy could cause injury or death. When working on any electrical equipment presenting these dangers, the Lockout/Tagout rule must be followed. This includes: servicing and/or maintenance, constructing, installing, setting up, adjusting, inspecting, modifying, lubricating, cleaning and “unjamming.” Exceptions: performing the above tasks on equipment with power cords. However, cord and plug equipment shall be unplugged, and all hardwired equipment is to have the breakers turned off, with locks or tags attached to the breaker or equipment to prevent personnel from re-energizing the equipment. This Lockout/Tagout policy covers electrical equipment as well as pressure and vacuum systems, water systems, and gas systems.

b. At least two employees shall be present when performing work involving the use of mechanical equipment, other than insulated aerial lifts, near parts energized at more than 600 volts, and/or when performing any other work that exposes an employee to electrical hazards greater than or equal to this example.

5. Working with Hazardous Chemicals:

a. In uncontrolled (open) areas: Two persons shall be required at all times when working with chemicals that have a National Fire Protection Association (NFPA) or Hazardous Materials Information System (HMIS) rating above (greater than) 1-Health; 3-Flammability; 1-Reactivity.

b. In controlled areas (within a fume hood that has current certification by the UW Safety Department and wearing the appropriate personal protective equipment, if applicable): A person may work alone using chemicals with a hazard rating no greater than 3-Health; 3-Flammability; 1-Reactivity.

c. Cryogenic liquids with an NFPA hazard rating of 3-Health; 0-Flammability; 0-Reactivity or less may be used in the vault and experiment preparation area with only one person present, provided the proper personal protective equipment (face shield and gloves) is worn.

d. NALCO or equivalent water system treatment tablets (NFPA hazard 3-1-1 or less) may be used, with only one person present, in the water treatment system located in the Heat Transfer Equipment Room (room # 105) by a qualified person*, provided the proper personal protective equipment is worn.

6. Machine Shop (KRC Safety and Procedures Manual page 29-1):

The following provisions shall apply to work conducted in the SRC Machine Shop, in addition to all general and after normal hours rules:

Only qualified persons* shall be allowed to work alone in the machine shop and use the tools and equipment. Qualification shall be determined based upon experience and/or training.

Qualified staff and users shall be allowed to operate the following equipment, located in the southwest area of the shop, following a basic training session and demonstration:

Drill Press
Small “Chop Saw”
Belt Sanders
Powered Hand Tools

All other shop equipment usage shall be limited to specially trained staff and users. The completion of a more comprehensive training program or demonstrated competence shall be required, along with specific authorization by the Engineering Manager, before personnel will be allowed to operate any other shop equipment.

7. Ladders and Scaffolds (KRC Safety and Procedures Manual pages 37-1 to 37-5):

Two persons shall be required when working from step ladders greater than 6 feet high, extension ladders, scaffolds, or elevated areas above four feet which are unguarded. Where applicable, fall protection rules must also be followed.

8. Set up of Equipment:

The following shall apply to the setup of equipment:

- a. Overhead crane lifting operations shall be followed when the overhead crane is being used, and two persons shall be required when the overhead crane provisions are exceeded; and/or
- b. When needed, SRC will have appropriate staff personnel on duty on “change over” Saturdays (day shift only), to ensure a second person is available for equipment set up.
- c. Lockout / Tagout procedures shall also be performed where applicable.

9. Working in a Vault Cleanroom or Isolated Area:

The following cleanroom usage policy shall be employed which involves use of the cleanrooms located within the SRC vault. A light shall be mounted on the external wall of the Vault Cleanroom, near the entrance. This light shall be wired to the light switch in the cleanroom changing area, so it comes on with the cleanroom changing area light. A sign stating

“Cleanroom In Use When Lit” shall be fabricated and hung directly below this light. The first person entering the cleanroom shall turn the light switch on, and the last person exiting the cleanroom shall turn off the light. (All staff using the vault cleanrooms shall be instructed on this new procedure.) This will assist the SRC Operators in verifying that the cleanrooms are not occupied when they are conducting their physical sweep (lockout procedures) of the vault prior to injections, and will assist in personnel location in the event of a fire or chemical emergency, or other emergency which would require the building to be evacuated.

10. Aerial Lift Operation:

All usage of KRC’s aerial lift, other than moving the unit from one point to another, shall require two persons.

11. Water on the Floor (electrocution, shock, slip, and fall hazards):

Anytime there is water on the floor, the person finding the water must immediately call the appropriate on-call staff member for instructions prior to taking any action, unless previously instructed on actions to take when water is found.

12. Requesting Other Assistance:

Employees should always assess the task they are about to undertake for hazards. If the employee determines that it is unsafe to perform the task as expected, the employee shall contact their supervisor during the normal shift. At all other times, the employee shall call the appropriate person identified on the emergency call list to discuss the options. If the employee is unable to reach these personnel, they should then call the on-call staff member.

* Qualified person: a person that has been authorized, based upon training and/or experience, to operate the specific equipment or perform the specific task being described.

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