I. Introduction

A. Background

North Dakota State University is involved with many materials that, during some phase of usage, may present a marginal to severe hazard to staff and students unless used properly. This is the basis of the formation of the NDSU Laboratory and Chemical Safety Committee and ultimately the establishment of this Chemical Hygiene Plan.

North Dakota State University has an ongoing concern for the safety and health of its employees, the student body, and the general public who may be exposed to University activities that involve the use of hazardous materials/substances or the generation of hazardous waste. The University recognizes a responsibility for ensuring that all campus activities involving hazardous materials/substances and hazardous waste are conducted with minimal hazard to employees, students, and the general public and in a manner so as to conform with applicable local, state, and federal regulations.

Biosafety
A separate biosafety policy and manual are maintained by the NDSU Institutional Biosafety Committee.

Radiation Hazards
A separate radiation hazard policy and manual are maintained by the NDSU Radiation Safety Committee.

Standard Operating Procedures
SOP's can be found in each laboratory and are the responsibility of each laboratory supervisor, see II.B: Training.

B. Levels of Responsibility

In order for the University to fulfill its recognized obligations and concerns, the policy of the University is to formulate and follow a chemical hygiene plan for the safe use and handling of hazardous materials/substances and proper disposal of hazardous waste. The plan provides for the training of employees and students involved with hazardous materials/substances. Levels of responsibility in this plan are as follows:

1. The University's Administration shall designate a Dean, such as the Dean of the Graduate School and Interdisciplinary Studies, to the University Laboratory and Chemical Safety Committee.

2. The University Laboratory and Chemical Safety Committee will:
   a. Maintain and revise the Chemical Hygiene Plan as appropriate to ensure compliance with regulatory changes.

   b. Advise the University Administration on changes to ensure regulatory conformity.

   c. Assist and support the Hazardous Chemical Officer in maintaining adherence to the chemical hygiene plan and other regulatory requirements.

3. The Dean of each College and the Chair or Head of each department shall be responsible for seeing that the Chemical Hygiene Plan is implemented and followed. The Chair or Head may designate a department representative for this purpose. The representative shall oversee the training of employees and students, and manage safety concerns in the department. The Chair or Head shall also verify implementation of corrective action for noted safety deficiencies.

4. The Hazardous Chemical Officer shall:
   a. Have authority to suspend any activity posing an imminent danger to students, employees, the general public, or the environment.

   b. Apprise the Laboratory and Chemical Safety Committee of regulatory revisions and recommend safety-related actions as the situation dictates.

   d. Cooperate with department safety representatives in adhering to the safety provisions in the chemical hygiene plan.

   e. Update and revise NDSU Laboratory and Chemical Safety training resources.

   e. Upon request, assist the department representatives in additional safety training for employees and students.

   f. Maintain records of trained personnel.

   g. Coordinate a safety inspection of each laboratory to determine adherence to this policy and other required regulations on at least an annual basis.

5. The Principal Investigator or Instructional Supervisor shall:

   a. Provide safety training in specific practices.

   b. Require workers and students under their supervision to follow safety procedures and use protective equipment as appropriate

   c. Be responsible for hazardous materials/substances in their possession.

   Additional requirements including more in-depth review of research protocols exist for the following materials and items:

   1.) highly toxic substances;
   2.) select agents and toxins;
   3.) highly reactive substances;
   4.) export-controlled items.

   Refer to Appendix 5 for more information on these substances and items.

   d. Ensure that the Hazardous Chemical Officer is notified of any accidental spill or potential exposure involving toxic substances.

   e. Correct safety and compliance deficiencies.

6. Employees and students shall have the responsibility of following the safety procedures as explained during training, using protective equipment as appropriate, and using hazardous materials/substances only in approved facilities.

C. Definitions

1. Hazardous Material

Materials that, during some or all stages of use, are a health and/or safety hazard for any creature or the environment. Hazardous and toxic substances/materials can be defined as those chemicals present in the workplace that are capable of causing harm. In this definition, the term chemical includes dusts, mixtures, and

common materials, such as paints, fuels, and solvents. OSHA - Hazardous Substance: 1) Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. 2) Any substance designated by the EPA to be reported if a designated quantity of the substance is spilled in the waters of the United States or is otherwise released into the environment.

2. Hazardous Materials/Substances Use
The controlled instructional laboratory, research laboratory, field, clinical, or maintenance use of materials for the purpose of demonstrating or developing a means of intended achievement. This includes all phases of materials handling, storage, application, and transportation. Examples of materials are acids, carcinogens, irritants, corrosives, flammables, germicides, pesticides, poisons, and oxidizers.

3. Hazardous Wastes
These are by-products, residues, spent materials, or other accumulations of altered, outdated, or unwanted materials that are hazardous. These materials exhibit properties of ignitability, corrosivity, reactivity, or toxicity and are more completely defined in Appendix 3. Hazardous Waste: By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed, possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special EPA lists.

4. Laboratory Use
The use of hazardous materials/substances for what is generally recognized as an approved academic or research laboratory activity.

5. Field Use
The use of hazardous materials/substances in a non-laboratory setting.

6. Instructional Supervisor - The individual who is directly responsible for developing and managing an academic laboratory or field activity.

7. Principal Investigator (P.I.) - The individual who is directly responsible for developing and managing a laboratory or field research activity.

II. Safety Program

A. Inventory Control

Each Principal Investigator (P.I.) or other authorized user is accountable for each hazardous substance or potentially hazardous operation in his/her possession from the time of receipt to its final disposal or depletion. The Principal Investigator must check Safety Data Sheets and labels to determine the hazards and toxicity of materials procured and under their control. A current inventory of hazardous materials/substances, by name, amount, and hazard classification shall be maintained for all substances in storage and/or use in each laboratory. This will serve to comply also with the North Dakota Employee Information (Right-To-Know) Act.

Each laboratory shall hold a current file of Safety Data Sheets (SDS), for all the materials used in that laboratory. This file should be visible from the entrance to the laboratory so that Emergency Services personnel can find relevant information quickly, if they are

called to an accident or incident. The SDS's must be organized in a manner that makes locating a specific SDS easy and quick. The Safety Office supplies specially marked, green three-ring binders for this purpose.

No hazardous material can be used before receipt and consideration of an SDS for that material. This includes material that is created at NDSU. Before a new material can be given to anyone else (for use, analysis, characterization, or any other reason) an SDS for that material must be created and must contain information that will protect the recipient of the material.

Note that each building has a storage limit for each class of hazardous material. It is important to ensure that hazardous storage does not exceed safety codes.

All containers that hold potentially hazardous materials/substances shall be labeled according to the NFPA code. Information on how to fill in the rankings for a particular material is often found in the SDS.

B. Training

The Department Chair or Head (or the Chair's/Head's designee) must ensure that all employees in that department subject to potential exposure to hazardous materials/substances are provided adequate health and safety instructions and training.

Each Laboratory Safety Course Module consists of an initial, comprehensive session that culminates in a quiz to gauge comprehension of the materials that were presented in that module. Annually thereafter, an online Refresher Training session must be completed that will review the most important aspects of Lab Safety Training and will highlight any changes that have taken place in the compliance laws over the past year. Information on these training titles can be found on the NDSU Police and Safety website on the Annual Notices and Training page.

- **Module 1: Employee Right to Know** - This module contains information about general laboratory safety issues and how to identify hazards in the workspace.
- **Module 2: Waste Handling Online Refresher *** - This module contains information on proper waste handling and is required each semester for all employees that generate hazardous waste. (*See additional information below)
- **Module 3: Fire and Electrical Safety** - This module contains information on fire and electrical hazards and gives the worker information that will help them respond to dangerous situations.
- **Module 4: Radiation Safety Topics** - This module contains basic radiation safety information and is designed to give a brief overview of this topic. Additional training requirements must be met if an employee will be actively working with radioactive material.
- **Module 5: Biohazard Topics** - This module contains basic information on biohazards and biosafety awareness for those laboratories dealing with infectious substances. Additional training requirements must also be met for those employees who work with Bloodborne Pathogens or as part of a research team under approval of the Institutional Biosafety Committee. See the links elsewhere

on this page for the Bloodborne Pathogen Training and/or the CITI Biosafety Training.

- **Module 6: Nanotechnology** - This module contains basic information on nanoscale materials and the unique safety issues associated with working with and around these items. It forms a foundation that can be built upon through additional laboratory specific training.
- **Module 7: Principal Investigator/Supervisor** - This module is designed to familiarize the Principal Investigator or Laboratory Supervisor with additional requirements and responsibilities associated with their role.

Module 2: Waste Handling carries additional requirements:

- Completion of in-person training is a requirement for employees who generate Hazardous Waste and the people who supervise them. This IN-PERSON requirement must be fulfilled at least once in your career at NDSU, regardless of how many online safety training sessions have completed in the past. There are no exceptions for previous training or longstanding experience.
- Completion is required for all North Dakota State University Employees—Faculty, Staff and Students—who could, or do, generate hazardous waste as part of their employment as well as anyone who supervises someone who could generate hazardous waste.
- In-person Module 2: Hazardous Waste training sessions will be scheduled at the beginning of each semester to accommodate new individuals or those whose duties or functions have changed such that they may generate waste or supervise those who do.
- Completion of ONLINE Hazardous Waste refresher training is required at the beginning of each semester, including summer semester.
- No individual should begin any lab work or any other activity that could include hazardous waste generation before satisfying these requirements.

Additional safety training may be required depending on work requirements and responsibilities. Training in specific work practices must be provided by the Principal Investigator or department designee.

1. The Hazardous Chemical Officer will:

   a. Update training materials as needed to answer compliance requirements.

   b. Maintain employee training records.

   c. Upon request, assist the Department Chair's designee or P.I. in additional employee training.

   d. Instruct custodial and maintenance personnel in the Hazard Communication

Standard.

e. Maintain Safety Data Sheets (SDS) for all hazardous materials/substances and have them available for use by employees and students.

2. The Department Chair, Chair's designee, Instructional Supervisor, or Principal Investigator will train laboratory workers in the following topics:

   a. Possible sources of toxic substances.

   b. Carcinogenic and other adverse health effects associated with such exposure.

   c. Work practices and use of proper equipment and facilities to limit exposures.

   d. Proper work practices to protect fellow employees.

   e. Emergency Procedures.

   f. Safety Training Documentation.

   Standard Operating Procedures for recurring hazardous tasks unique to a particular lab should be written by the Principal Investigator or Instructional Supervisor. Students and staff shall be apprised of the SOP's and instructed in their contents. Each laboratory should contain a current file containing all the relevant SOP's. Operating manuals for instruments and equipment will fulfill SOP requirements for using them provided that the responsible staff has ascertained that they contain adequate safety guidance.

C. Control Strategy

This section describes situations in the use of hazardous substances where different levels of safeguards are specified to protect the employee or student. For information about required safety measures for a particular laboratory, type of chemical, or quantity of chemical, the SDS or SOP file for that laboratory should be consulted. The Hazardous Chemical Safety Officer should be consulted if no other guidelines are available.
The hazard in working with toxic substances is a function of the exposure potential and the toxicity of these substances. The risk of exposure to a toxic substance is related, among other things, to the quantity and physical properties of material used and the nature, frequency, and complexity of the experimental procedure. There may be a greater risk of exposure when working with 100 mg of the same material than with 1 mg of material. Similarly, the potential for exposure may be greater during blending, preparation of dry feed mixture, and in the manipulation of powders than during the preparation of aliquots of stock solution.

Chemicals of unknown identity or known chemicals whose toxicity, carcinogenicity, or stability is unknown cannot be used until their current SDS has been received and understood.

Chemicals that have been synthesized in the laboratory should be labeled by contents, date of synthesis, and owner, and have an NFPA label according either by comparison with known, analogous materials, or according to the most hazardous material included in the synthetic procedure.

If synthesized chemicals are transferred within NDSU research groups, the hazards of

the material must be communicated with the group receiving the material. If synthesized chemicals are transferred to non-NDSU research groups, SDS's must be created and must accompany these chemicals. The party responsible for the creation of the SDS's is the PI or their designee. The SDS format should follow the ANSI recommendations using the 16 standardized sections. See the Safety Office website for information on how to create these forms.

Department of Transportation (DOT) hazardous material regulations would apply if the synthesized chemical were to be transported from NDSU property. To ensure DOT shipping regulations are followed, coordinate with one of the members of your department who has received DOT shipping training. The Safety Office may also be contacted for guidance.

Departments who transport hazardous materials on campus from building to building must comply with the DOT requirements including training. Specifically, when transporting hazardous materials on campus, faculty, staff, and students must use:

- Only interior campus roads. Not 18th Street N, 12th Avenue N, etc.
- Only State Fleet vehicles or complete the transfer by foot.

Do not use private vehicles or public transportation to transport hazardous materials.

If transport of your material requires the use of public roads, additional DOT regulations may apply. Contact the Safety Office for assistance.

Based on the factors just discussed, control practices needed in a laboratory will fall into one of three categories:

1. Low Risk Situation

Safety during operations with non-regulated compounds can normally be achieved by strict adherence to good laboratory practice.

The laboratory worker must not eat, drink, smoke, chew gum or tobacco, apply cosmetics, or store food in areas where the toxic substances are used or stored. Personal items such as pens, cell phones, etc. should not be brought into a laboratory area. These items can be easily contaminated in a lab, greenhouse, or workshop space and the contamination spread from there. Gloves should be worn or hands must be washed following the completion of a procedure in which toxic substances are used. The laboratory workers must develop the habit of keeping hands away from mouth, nose, eyes, and face. A laboratory coat and gloves must be worn when handling hazardous substances. Mechanical pipetting aids must be used for all pipetting procedures.

Stock quantities of compounds must be maintained in a secured and appropriate storage area when not in use.

2. Intermediate Risk Situation

More stringent safeguards are required for certain research investigations. For example, more stringent requirements may be needed for research activities that involve more potent toxic substances as well as for substances for which there are recognized hazards of intermediate risk.

Stock quantities of compounds in this category should be stored in purpose-built cabinets according to safety and building codes. In the research laboratory, minimum quantities should be available as dictated by programs of study. The quantities in the laboratory should be limited to the lowest amount reasonable for the specified use.

The preparation of dilute solutions or the removal of small amounts of a toxic substance from stock quantities should be performed as much as possible within a laboratory fume hood or glove box. The work surfaces of the hood must be covered with stainless steel or plastic trays, dry absorbent plastic-backed paper, or other impervious material.

3. High Risk Situations

All laboratory procedures that involve the use of carcinogens, or very potent toxic substances, may require work practices and engineering controls in addition to those previously discussed. These may include: face-fitted respirators with filtering cartridges specific to the hazard, additional or more frequent changes of protective clothing, shower facility and change room, use of primary containment devices, work area access control, and monitoring for environmental contamination resulting from certain laboratory operations. Protective clothing such as disposable pants, shirts, jumpsuits, shoes and head covers, and plastic and latex gloves must be worn as appropriate. Showers are recommended after each exit from the work area.

These substances require special facilities for handling. The module must have a separate hood exhaust and glove box or other completely closed containment system. Work areas must be separated by a controlled access area from areas that are open to unrestricted traffic flow. This controlled access area may be an anteroom, a change room, and air lock, or any other door arrangement that separates the laboratory from areas of unrestricted traffic flow. Areas which meet these requirements are called Carcinogen Dilution Modules. Laboratories which do not have a Carcinogen Dilution Module must obtain permission from the Hazardous Chemical Safety Officer for the use of the existing facilities or must construct an equivalent facility of their own for laboratory operations that involve the storage or handling of these chemicals.

D. Facility Requirements (minimum)

1. A hand washing facility must be available within the work area. (This need not be a facility used exclusively for hand washing.) The use of liquid soap is recommended. In new facilities, foot or elbow operated faucets should be provided.

2. An emergency drench shower shall be located in any area where toxic or corrosive chemicals are used. The shower facility must be clearly marked.

3. A secondary shower facility adjacent to the work area is recommended for total body cleansing in areas where acutely toxic substances are used.

4. A fire blanket should be maintained in a laboratory area where high voltage equipment or similar hazards would make the use of a safety shower dangerous. The location of the blanket must be clearly marked.

5. An emergency eye wash facility must be located in each laboratory. The eye wash facility must be clearly marked.

6. All emergency stand-alone eye wash stations must be tested on a weekly basis. All bottled eye wash stations must be within the noted expiration date.

7. A laboratory fume hood shall serve as the primary hazard control device while working with toxic or other hazardous materials/substances. Each laboratory in which volatile hazardous materials/substances are used shall have a functional

fume hood with adequate face velocity and ventilation according to laboratory and building codes. In any case ventilation should be sufficient to remove all vapors to the exterior of the building and not endanger people outside the building.

8. Each laboratory shall have proper, purpose-built storage facilities, depending on the chemicals used in the laboratory, e.g. flammables, corrosives, etc.

9. Each laboratory should have a spill kit suitable for the materials used in that laboratory. This should be kept by the entrance to the laboratory to ensure access to it.

10. Each laboratory shall have specific waste containers for broken glass and other sharp waste. Special sharps containers are available from the Safety Office.

11. Each laboratory shall keep available sufficient eye protection for visitors.

12. The functioning of emergency showers, blankets, etc. should be checked monthly.

13. Any shower or eye wash that is not in good working order must be corrected by submitting a work order to Facilities Management.

E. Operational Practices

1. Entrances to all work areas where hazardous substances are being used or stored must be posted with a sign stating that ***"This room contains Chemical and/or Electrical Hazards",*** and the name of the P.I. or Instructional Supervisor, and other emergency contacts and phone numbers. A standard sign for this purpose is available from the Hazardous Chemical Safety Officer.

2. Access doors to work areas where carcinogens or highly toxic substances are used or stored should be kept closed while experiments with such substances are in progress.

3. All work surfaces (bench tops, hood floors, etc.) on which toxic substances are used must be covered with stainless steel or plastic trays, dry absorbent plastic-backed paper, or other impervious material. The protective surfaces must be examined for possible contamination immediately after each procedure with a toxic substance has been completed. Contaminated surfaces must be decontaminated or disposed of according to prescribed procedures.

4. Procedures involving volatile toxic substances and those involving solid or liquid toxic substances that may result in the generation of aerosols must be conducted in a laboratory fume hood, a glove box, or other containment equipment. Examples of aerosol-producing procedures are the opening of closed vessels, transfer operators, weighting, preparation of feed mixtures, and the application, injection or incubation of a toxic substance into experimental animals. Biological hazards or radiation hazards must be treated according to the appropriate manual.

5. Toxic vapors or aerosols produced by analytical instruments must be captured through local exhaust ventilation or appropriate trap at the site of their production. The instruments may be placed entirely within a laboratory fume hood if this will not impair hood performance (i.e., toward the back and raised on legs to minimize turbulence of inflowing air). When a sample is removed from the analytical instrument, it must be placed in a tightly stoppered sample tube or otherwise safeguarded from contaminating the laboratory. In the event that the

analytical equipment becomes contaminated, it must be labeled ***"CAUTION - TOXIC SUBSTANCE"*** until it has been completely decontaminated. This operational practice applies to analytical equipment even when only infrequently used for toxic substances.

6. Stock quantities of toxic substances must be stored in a specific storage area that is secure at all times. The storage area must be posted with a sign bearing the legend: **"*CAUTION - Toxic Chemical Storage Area".*** Additional storage precautions may be required for compounds with properties such as flammability, radioactivity, etc.

7. Laboratory areas, including chemical storage areas shall be secured from access by unauthorized persons. Such security shall be maintained by:

   - Storing materials in lockable storage areas or laboratories.
   - Storing and using the materials in a laboratory or room that is locked when unattended.

   Furthermore, access to the laboratory areas should be limited to persons with laboratory or maintenance related functions. Unfamiliar persons entering the laboratories should be asked for the purpose of their presence.

F. Personnel Practices

1. Precautionary

Know the safety rules and procedures that apply to the work you are doing; make note of the appropriate safety precautions and potential hazards via SDS's and SOP's before beginning any operations.

Review the applicable emergency procedures; know where the emergency equipment is located in your area, how to use it, and how to obtain help in an emergency.

Assure the availability of the proper protective equipment and use the proper type for each operation.

Be alert to unsafe conditions and actions and have them promptly corrected. Someone else's accident can be as dangerous to you as any you might have.

Remain out of the area of a fire or personal injury unless it is your responsibility to help meet the emergency.

2. Protective Clothing

A fully fastened, laboratory coat and full-length pants must be worn by employees in laboratory areas when using hazardous substances. Major purposes of the laboratory coat are to protect the individual and to reduce the probability of taking toxic contamination from the laboratory. The laboratory coat should be removed when leaving the work area and should not be worn in the cafeteria, library, conference rooms, auditorium, or other common meeting places.

Clothing contaminated by toxic substances must be decontaminated or disposed of immediately after an obvious exposure. Contaminated clothing must not be sent to the laundry until decontaminated. In situations where decontamination is not feasible, clothing must be disposed of as hazardous waste, in a manner approved by the Safety Office. Gloves which are appropriate to the specific

situation must be used when handling toxic substances. Disposable gloves may be used only once and then must be discarded into a properly labeled container. Such gloves must be discarded immediately after known contact with a toxic substance.

Garments that fully cover the legs are required to prevent chemicals from spilling or splashing on exposed skin. Shorts, cut-offs, pedal-pushers, dresses, and skirts may not be worn when working in the lab and undertaking procedures involving hazardous materials/substances. Loose-fitting garments that may become entangled in equipment or inadvertently dragged through a contaminant are not allowed. Whenever procedures involving toxic or corrosive substances are undertaken, lab coats and a garment that completely covers the legs must be worn. In normal laboratory work, special shoes are not required. However, footwear must provide adequate traction, support, and resistance to chemical spills. Athletic-type shoes are allowable provided the upper is intact and does not allow a liquid to readily soak through. Socks should be worn. Sandals, open-toed shoes, and cloth shoes are not allowed.

3. Pipetting

Mechanical pipetting aids must be used for all pipetting procedures. Oral pipetting is prohibited!

4. Eye Protection

Safety glasses must be worn by all workers and visitors in all specified laboratory work areas. Contact lenses may not be worn in certain laboratory work areas. Safety glasses with side shields provide the minimum protection acceptable for regular use. They must meet the American National Standards Institute (ANSI) Z87.1 Standard for Occupational and Educational Eye and Face Protection, which specifies minimum lens thickness and impact resistance requirements.

Chemical splash goggles are more appropriate than regular safety glasses to protect against hazards such as projectiles, as well as when working with glassware under reduced or elevated pressures (e.g., sealed tube reactions), when handling potentially explosive compounds (particularly during distillations), and when using glassware in high-temperature operations. Chemical splash goggles or face shields should be worn when there is a risk of splashing hazardous materials or flying particles.

Because chemical splash goggles offer little protection to the face and neck, full-face shields should be worn in addition to safety glasses or goggles when conducting particularly hazardous laboratory operations (e.g., working with glassware under vacuum or handling potentially explosive compounds). In addition, glassblowing and the use of laser or ultraviolet light sources require special glasses or goggles.

It is the responsibility of the laboratory supervisor or the Principal Investigator to determine what additional eye protection may be required for a particular operation.

Ordinary prescription glasses do not provide adequate protection against injury because they lack side shields and are not resistant to impact, but prescription safety glasses and chemical splash goggles are available.
Similarly, contact lenses offer no protection against eye injury and do not substitute for safety glasses and chemical splash goggles. They should not be worn where chemical vapors are present or a chemical splash or chemical dust is possible because contact lenses can be damaged under these conditions. If,

however, an individual chooses to wear contact lenses in the laboratory, chemical splash goggles must be worn.

5. Personal Conduct

a. Personal hygiene must be maintained if toxic substances are used; fingernails must be short and clean; hands and arms must be washed thoroughly before handling any object that goes to the mouth, nose, or eyes, and before leaving the laboratory.

b. Toxic materials may not be handled by personnel with an unprotected break in the skin; the break must be covered with adhesive tape and appropriate rubber or vinyl gloves must be worn.

c. There must be no eating, drinking, chewing gum or tobacco, smoking, or applying cosmetics while working in areas where toxic substances are in use; refrigerators in such areas must not be used for storing food or beverages. Personal items such as pens, cell phones, etc. should not be brought into a laboratory area. These items can be easily contaminated in a lab, greenhouse, or workshop space and the contamination spread from there.

d. Distracting or startling other workers must be avoided; practical jokes or horseplay cannot be tolerated at any time in the laboratory.

6. Housekeeping

a. Laboratories where toxic materials are handled must be kept neat and clean; clean-up procedures are required upon completion of each operation at the end of each day.

b. Work areas must be free of equipment and material not required for the immediate operation.

c. All chemicals must be correctly and clearly labeled with standard, diamond-shaped NFPA labels and stored; warning signs are required when unusual hazards exist such as radiation, laser operations, flammables, biological hazards, or other special concerns.

d. Applicable waste preparation and disposal procedures must be followed; chemical reactions may require traps or scrubbing devices to prevent the escape of toxic gases.

e. Exposure to hazardous and toxic vapors, mists, gases, and dusts must be minimized by preventing the escape of such materials into the working atmosphere; adequate ventilation must be ensured by use of exhaust hoods and other local ventilation.

Equipment must be used only for its designed purpose.

Reaction apparatus must be carefully positioned and clamped to permit manipulation without the need to move the apparatus.

Reagents must be combined in appropriate order; avoid adding solids to hot liquids, water to acids, etc.

7. Personal Monitoring

Each person is responsible for ensuring that his/her person, clothing, shoes, laboratory equipment, and work area surfaces are kept free of contamination.

Before leaving the laboratory for even short periods, contaminated clothing must be removed; showering may also be necessary before leaving the laboratory for lunch and at the end of the day when highly toxic materials are being used by anyone in the laboratory. (When in doubt concerning the degree of toxic substance hazards present, consult the Hazardous Chemical Safety Officer for advice and assistance.)

8. Working Alone

A written hazard assessment evaluating the work environment including any necessary laboratory tasks must be completed by the Principal Investigator or laboratory supervisor prior to anyone working alone in a laboratory. Consideration should be given to the hazards present and perhaps elevated by working alone. Working alone shall not be permitted if experiments involve known and significant hazards. If the hazard assessment indicates that working alone is acceptable, it is recommended that an arrangement be made with others to cross check periodically. When the lone worker has finished for the day, they must contact the P.I. and report that they are leaving for the day and provide a status report for the lab.

9. Leaving Employment at NDSU

All instructional, administrative, and research personnel are required to dispose of laboratory and chemical hazards for which they have been responsible. First, they must ascertain that the materials are unwanted, then they must dispose of the materials according to the guidelines in Section V - Chemical Waste Management. Personnel may only leave employment when the exit form has been properly executed according to this requirement.

Any materials left behind by someone leaving NDSU become the responsibility of their supervisor or the department leadership. If hazardous materials are discovered that were left behind by someone leaving NDSU, the Safety Office will determine whether or not to invite a hazardous materials vendor into the lab to correct the situation. All associated costs will be borne by the department to which that lab or workspace belongs.

G. Inspections

Laboratory safety inspections will be conducted at least annually for compliance with the Chemical Hygiene Plan. The inspections will be coordinated by the Hazardous Chemical Safety Officer. They may be conducted by the department Safety Representative, the Principal Investigator, or the Safety Officer at the direction of the Laboratory and Chemical Safety Committee. Noted deficiencies will be reported to the appropriate Chair, Head or Director of a Department, or the responsible trades area of Facilities Management with a time frame for corrective action. For particularly hazardous situations, immediate response may be indicated. Expectation is that the noted items will either be corrected or a plan of corrective action will be prepared and submitted to the Safety Office within the timeframe for corrective action. Periodic follow up inspections will verify corrections have been implemented. If, upon re-inspection, the deficiency still remains and no corrective action plan has been implemented, an additional report will be submitted to the original recipient's supervisor. This escalation process will continue up through the Vice President level at which point any non-compliance reports will be submitted to the University Internal Auditor and access to the lab space may be suspended.

Hazardous Waste Handling Inspections will be conducted at least monthly in every space in which hazardous waste might be generated. Noted deficiencies will be reported via email to the P.I. or designated person on the Emergency Contact poster that is on the

door to the space where the deficiency was found, and repeated deficiencies will be reported to the Department Chair, the Dean, the Provost, and the VP for Research. Re-inspection will occur daily thereafter until the deficiency has been corrected. If the deficiency remains uncorrected for more than three days, the lab will be locked and everyone with access to that lab will be required to attend in-person hazardous waste handling training. This will include student workers, graduate students, post docs, PI's, and the Department Chair. The Safety Office will determine whether or not to invite a hazardous materials vendor into the lab to correct the situation. All associated costs will be borne by the department to which that lab belongs.

III. Working with Nanomaterials

A. Introduction

Nanotechnology is the manipulation of matter on a near-atomic size scale to produce new structures, materials, and devices. Materials exhibit unique properties at the nanoscale level, which affect their physical, chemical, and biological behavior. Nanomaterials are engineered materials having at least one dimension between 1 and 100 nanometers.

Nanomaterials are of considerable scientific interest because some material properties change at this scale. However, these changes also challenge researchers' and safety professionals' understanding of hazards, and their ability to anticipate, recognize, evaluate, and control potential health, safety, and environmental risks.

The following program does not include incidental, unintentionally produced, naturally occurring nanomaterials, nano-sized particles, such as viruses, volcanic ash, and nanoparticle byproducts of human activity.

B. Purpose

The purpose of the Nanomaterials Safety Plan is to provide a structure for recognizing, evaluating, and controlling hazards associated with nanomaterials research.

Exposures to these materials during research and development may occur through inhalation, dermal contact, or ingestion. Nanomaterials present new challenges to understanding, predicting, and managing potential health risks. They may interact with the human body in different ways than conventional materials, due to their extremely small size. For example, studies have established that the comparatively large surface area of inhaled nanoparticles can increase their toxicity. Such small particles can penetrate deep into the lungs and may move to other parts of the body including the liver and the brain.

The nanoparticulate forms of some materials show unusually high reactivity especially for fire, explosion, and catalytic reactions. Depending on their composition and structure, some nanomaterials may initiate catalytic reactions that would not otherwise be anticipated from their chemical composition.

At the current time, there are no federal regulations that specifically address health and safety implications of nanotechnology. Through DOE Policy 456.1 Secretarial Policy Statement on Nanoscale Safety and other communications, the Department of Energy has made it clear that it expects those engaged in nanoscience in DOE facilities to evaluate and control associated environmental, health, and safety risks.

As with conventional chemicals, research with nanomaterials must be conducted in a manner that is safe and responsible. This Chemical Hygiene Plan provides guidance for

working with toxic materials having hazardous properties. Nanomaterials will be treated as though they are toxic and otherwise hazardous material unless and until evidence shows otherwise.

Nanomaterials whose hazards have been studied should be managed in a manner consistent with the disclosed risks.

C. Control Preferences

In order to provide a safe work environment for research personnel, students and visitors, controls must be maintained wherever nanomaterials are used or stored. These controls may include engineered controls, administrative controls, and use of personal protective equipment.

D. Engineering Controls

1. Ventilation

- Conduct any work that could generate dispersible nanoparticles in an enclosure that either operates at a negative pressure relative to the worker's breathing zone, or is sealed. Examples of such enclosures include laboratory bench-top or floor-mounted chemical hoods and glove boxes.

- If the process cannot be enclosed, then any location at which nanomaterial or a hazardous precursor can enter the atmosphere should be controlled using other appropriate engineering controls. Examples include: a local exhaust system (i.e. A snorkel hood) or dedicated low-flow enclosures.

- Prior to release filter or scrub effluent (air) that has been demonstrated or is strongly suspected to contain nanoparticles whose hazards are not well understood.

- HEPA filtration is recommended.

- If it is not practical to handle dispersible nanoparticles in a containment system such as glove box, glove bag, chemical fume hood, or other airborne containment control system, a hazard analysis including workplace monitoring shall be conducted in conjunction with the NDSU Safety Office and documented before implementing alternative hazard controls.

- Do not recirculate exhaust containing nanoparticulate materials within the laboratory.

- Filters, scrubbers or bubblers appropriately used to treat unreacted precursors and effluent may also be effective in reducing nanomaterial emissions. If using portable bench top HEPA filter units, exhaust them to the local exhaust system.

- Exhaust Type II biological safety cabinets, in which free nanomaterials are handled, directly to the lab ducting. Air from inside the cabinet, even if filtered, shall not be recirculated within the laboratory.

E. Administrative Controls

1. Housekeeping

- Practice good housekeeping in laboratories where nanomaterials are handled.

- Maintain working surfaces free of engineered nanoparticle contamination, insofar as practicable.

- Perform precautionary cleaning in areas where engineered nanoparticle might settle. For example, wipe horizontal surfaces with a moistened disposable wipe. This should be done no less frequently than at the end of each shift.

2. Work Practices

- Transfer nanomaterial samples between workstations (such as exhaust hoods, glove boxes, furnaces) in closed, labeled containers, such as marked and sealed bottles or "Zip-Lock" bags.
- Take reasonable precautions to minimize the likelihood of skin contact with engineered nanoparticles or nanoparticle-containing materials likely to release nanoparticles (nanostructures).
- If engineered nanoparticle powders must be handled without the use of exhaust ventilation (i.e., laboratory exhaust hood, local exhaust) or enclosures (i.e. glove box), evaluate hazards and implement alternative work practice controls to minimize the likelihood of contamination and exposure hazards (vide infra).

3. Signage

- Post work areas with the **Designated Nanoparticle Work Area** sign where nanoparticles are handled. This could be either a work area within a lab, or the entire lab.
- If engineered nanoparticulate powders must be handled without the use of exhaust ventilation, post the entire lab as **Designated Nanoparticle Work Area** and use appropriate personal protective equipment (vide infra).

4. Labeling

- Indicate on container labels that the contents are in nanoparticulate form, e.g., **nanoparticulate zinc oxide** rather than simply **zinc oxide**.
- If the morphology (shape) of the nanoparticles is known, this information should be included on the label as fibers may pose a greater hazard than spheres.

F. Personal Protective Equipment

1. General requirements

- Wear appropriate personal protective equipment on a precautionary basis whenever the failure of a single control, including an engineered control, could put researchers or support personnel at significant risk.
- The Principle Investigator, in conjunction with the NDSU Safety Office personnel will conduct a hazard evaluation to determine the selection and use of appropriate personal protective equipment.

2. Clothing

Wear clothing appropriate for a laboratory as per Section II.F.2. of this plan and including:

- Close-toed shoes made of a low permeability material. (Disposable over-the-shoe booties may be necessary to prevent tracking nanomaterials from the laboratory.)

- Safety glasses with side shields
- Disposable laboratory coats. These coats should be handled as hazardous waste.
- If non-disposable laboratory coats are preferred, they should remain in the laboratory area to prevent nanoparticles from being transported into the common areas. The coats should be placed in closed bags before being taken out of the laboratory for cleaning.

3. Gloves

- Choose and wear appropriate gloves after considering the resistance of the glove to the chemical attack by both the nanomaterial and, if suspended in liquids, the liquid.
- Exposure to nanomaterials is not known to have good warning properties so gloves should be changed frequently.
- The contaminated gloves should be kept in a closed container in the work area until disposal as hazardous waste.
- Outer gloves made of other material, such as cotton, may be used for protection when handling nanomaterials in bound form.
- Wash hands and forearms after wearing gloves.

4. Respiratory Protection

- The appropriate respirator and cartridge combination should be worn when deemed necessary by a safety assessment directed by the Principle Investigator in conjunction with NDSU Safety Office personnel.
- Personnel must complete the NDSU Respiratory Protection Program. If a respirator is indicated, it should be at a minimum half-mask, P-100 cartridge-type respirator that has been properly fitted to the worker.
- **Dust masks** shall not be worn in the place of a half mask respirator with a P-100 cartridge.
- Spent P-100 cartridges will be considered and handled as hazardous waste.

5. Exposure Assessments

- The Principal Investigator should consider baseline monitoring of nano activities by measuring conditions prior to start up. Measurements should be taken again at the conclusion of system commissioning and periodically thereafter.
- If nanoparticle exposure is suspected, contact the NDSU Safety Office to arrange an area survey.

G. Personnel Identification

Any staff member meeting one or more of the following criteria will be considered an **engineered nanoparticle worker**:

- Handles engineered nanoscale particulates that have the potential to become dispersed in the air.
- Routinely works in an area in which engineered nanoparticles have the potential to become dispersed in the air.
- Works on equipment that is believed to be contaminated and could foreseeably release engineered nanoparticles during servicing or maintenance.
- Workers who satisfy the definition of an “engineered nanoparticle worker” shall be appropriately trained (vide infra).

H. Training

- Workers must receive appropriate training prior to working with nanomaterials. This includes the reading of laboratory-specific nano SOPs

and this section of this Chemical Hygiene Plan. The inclusion of specific procedural requirements into the laboratory-specific nano SOPs will lead to better understanding and competence of the worker. Training should cover requirements and recommendations for:

- Engineered controls employed
- Use PPE
- Cleaning of potentially contaminated surfaces
- Steps to be taken in the event of an exposure incident or spill
- Specific nanomaterial-related health and safety risks
- Do not assume that staff members and visiting researchers are aware of the health and safety concerns posed by nanomaterials. Alert personnel in each group to potential hazards and to NDSU policies regarding nanomaterials.

I. Medical Surveillance

- Employees with jobs involving the potential for [or reasonably anticipated] respiratory or skin exposure to nanomaterials must have their name added to the list of NDSU nanomaterial workers. The list of employees shall be sent by the Principal Investigator to the Safety Office.
- The list of nanomaterial workers will be maintained by the NDSU Safety Office.
- Any employees involved in any incident that results in an unexpected and/or unusually high exposure to nanomaterials, through any route of entry, should be examined by the designated medical provider.

J. Waste

- Do not dispose of nanomaterial-bearing waste streams directly into the sanitary sewer system (i.e. down a sink drain).
- Evaluate surface contamination or decontaminate equipment used to manufacture, handle, or capture nanoparticles before disposing or reusing it.
- Label Hazardous Waste Log sheet and label container as to waste containing nanomaterials.
- Package nanomaterial-bearing waste in containers that are compatible with the contents, in good condition, and that afford adequate containment to prevent the escape of the nanomaterials.
- Do not place nanomaterials in the regular trash.
- Used HEPA filters must be labeled as being contaminated with nanoparticles, collected, and disposed of as hazardous or potentially hazardous waste.

K. Nanomaterial Spills

- Determine the extent of the area reasonably expected to have been affected, and demarcate it with barricade tape or use another reliable means to restrict entry into the area.
- For clean-up of significant spills, call 1-7759 for assistance. Indicate that the spill involves nanomaterials.
- For smaller spills, trained nano workers can clean up the spill following their laboratory's specific spill plan.
- Any worker exposed to nanomaterials as the result of a spill or in the course of a spill clean-up must file an NDSU Incident Report.
- At a minimum, the following procedures must be followed when managing an accidental spill of nanomaterials.

Dry Material Spills

- Position a walk-off mat (e.g., Tacki-Mat) where clean-up personnel will

exit the access-controlled area to reduce the likelihood of spreading nanoparticles.

- Clean using wet wiping methods. Manage, collect, and dispose of spill clean-up materials as nanomaterial-bearing waste.
- Do not dry sweep spilled accumulations of dry nanomaterials. Use only HEPA-filtered vacuum cleaners to clean up nanoparticles.
- If vacuum cleaning is employed, care should be taken that HEPA filters are installed properly, and bags and filters changed according to manufacturer's recommendations.
- Consider the possible air reactivity of nanoparticles prior to using a vacuum cleaner. Some normally stable powders may become pyrophoric if deposited on a filter and subject to high airflow.

Liquid Spills

- Employ normal HazMat response based on the spilled material's known hazards. The following are additional considerations to mitigate nanomaterials left behind once the liquids have been removed.
- Position an absorbent walk-off mat where the clean-up personnel will exit the access controlled area.
- Place barriers (e.g. plastic sheeting) to minimize air currents across the surface affected by the spill.
- Use a wet-wiping method to clean the spill. A HEPA-filtered vacuum may also be used to clean up residual nanomaterials left behind after the spill area has dried.
- Manage materials used to clean up the spill (absorbent mats, absorbent material, wipes, etc.) as hazardous or potentially hazardous waste based on the material involved.

IV. Emergency Procedures

Emergencies will generally be in the nature of personal injuries, spills, fires, or explosions, which may result in the spread of hazardous material.

The primary consideration is to deal with the emergency. Alert a responsible person; the appropriate emergency services should be called directly, if necessary. The Safety Office should then be notified. Since it is not possible to devise a set of rules or procedures to govern all possible emergencies, the considerations in Appendix 1, Section IV are presented only as a guide to aid the user in establishing more specific emergency procedures applicable to his or her working conditions.

All employees are responsible for reporting any accidental spill of a toxic substance and accidents involving potential exposure (inoculation, ingestion, dermal contact, and inhalation) to the Hazardous Chemical Safety Officer and the Principal Investigator. The Hazardous Chemical Safety Officer will coordinate the accident-reporting requirements and the clean-up procedures.

A. Near Miss or Hazardous Situation

1. In accordance with guidance provided in NDSU Baseline Safety Training, an Incident/Near Miss Report shall be filed when an employee is involved in or witnesses an incident that did not result in personal injury or property damage, but had the potential to do so and could happen under the existing conditions.

2. An Incident/Near Miss Report shall be filed when circumstances arise that constitute a hazardous situation. This is the mechanism whereby corrections can

be made prior to an accident, spill, etc.

V. Chemical Waste Management

These guidelines are intended to provide safe, practical methods for the management of hazardous chemical waste at North Dakota State University.

For materials that require removal and disposal, a pickup service is provided by the Hazardous Chemical Safety Office at 1-7759.

A. General Policies

1. Contact the University Police & Safety Office - Safety Office, at 1-7759 for any questions regarding the proper handling/disposal method of a particular material.

2. The Principal Investigator (PI) or Instructional Supervisor has the responsibility for identifying and labeling chemical waste generated. Guidance to the definition of hazardous waste is contained in Appendix 3. The PI/Supervisor must follow all procedures in these guidelines and shall provide proper instruction to personnel under their jurisdiction.

3. Do not dispose of chemicals unnecessarily. If you have no further need of a reagent, determine whether or not colleagues at your site can use it. Use and redistribute materials according to their intended purpose, if possible, to alleviate disposal problems.

   NOTE: Hazardous Materials shall not be offered for transport thru shipping channels without the shipper of said material having completed a Hazardous Material Shipping Training and receiving a certificate of completion. Please reference the NDSU Hazardous Material Shipping Procedures available through the University Police & Safety Office - Safety Office, 1-7759.

4. Waste or outdated chemicals should not be allowed to accumulate in any location to a point that would create an unsafe working environment for laboratory personnel, students, or other workers.

5. Waste chemicals should always be segregated and labeled according to compatibility while being stored prior to being removed by the Hazardous Chemical Officer. The segregation of chemicals assures the safety of the chemical user and Hazardous Chemical Safety personnel and regulatory compliance for the University.

6. Do not mix (e.g. halogenated solvents with non-halogenated solvents) waste chemicals. Collect the material in separate waste containers if at all possible. Mixing of waste increases disposal costs.

7. When a waste container is used for compatible chemicals, each chemical must be identified, and its percentage of the final mixture must be indicated.

8. Empty containers should be triple-rinsed, using either water or a solvent capable of removing the original material. Be aware that the liquid used to rinse may be contaminated and should be collected for proper hazardous waste disposal. All empty, rinsed chemical containers should be recycled through the Safety Office.

9. Unknown material cannot be disposed of (under State and Federal law) until the

unknown has been properly identified. Charges for analytical services are expensive and it is to your advantage to properly label and identify all material in your work area. The chemical user/department will be charged for any analytical work necessary to identify unknowns.

10. Chemical waste disposal is expensive; therefore, every effort must be made to keep the quantities of hazardous chemicals to a minimum. When planning research and ordering materials, this should be taken into consideration (i.e. don't order 5 gallons if only one gallon is needed, even if the 5 gallon quantities have a lower unit cost).

11. Chemical waste generated at the University can be either non-hazardous solid waste or hazardous chemical waste. The term **waste disposal** refers to the process operated by the Hazardous Chemical Safety Officer which provides technical assistance in handling and preparation for disposal of hazardous chemical waste by contract disposal firms (see Appendix 2).

12. Call the Safety Office to dispose of all chemicals. Do not sewer chemicals or put materials in normal laboratory waste streams unless completely confident that they will do no harm to the janitorial staff, other service personnel, or the environment (this includes tissues, disposable gloves, etc. or other materials used to clean up spilled chemicals).

Appendix 1 - Guidance on Spills and Other Accidents

I. Minor Spills Involving Minimal Toxic Hazards to Personnel

A. Notify all other persons in the room at once and, before proceeding with the cleanup notify the Hazardous Chemical Safety Officer.
B. Confine the spill immediately.
C. Permit into the area only the minimum number of persons required to deal with the spill.

1. Liquid spills:
a. Wear protective gloves,
b. Place Lab-Sorb neutralizer (or some other compatible sorbent material), or absorbent paper, on the spill.

2. Dry spills:
a. Wear protective gloves.
b. Dampen spilled materials thoroughly taking care not to spread the contamination; use caution in dampening fine, dry particulate material so as not to create an aerosol; where chemical reactions with water are possible, use oil as an agent.
c. Use swipe tests or fluorescence tests to assure adequate cleanup.
d. Establish a plan and begin decontamination.
e. Monitor all persons involved in the spill and cleanup operations.
f. Prepare and submit to the Hazardous Chemical Safety Officer a complete description of any accident or spill involving a toxic substance and subsequent remedial and protective actions taken. This should be done on the NDSU Incident/Near Miss Report Form.

II. Major Spills Involving Toxic Hazards to Personnel

A. Anyone involved in a spill must notify all persons not involved in the spill to vacate the area at once and limit the movement of displaced persons to confine the spread of contamination.
B. If the spill is liquid, use a stick, tongs, or lever to place the spill container upright; the hands may be used only if protected or gloved appropriately. Spill kits are available and are required for limited access areas and laboratory rooms.
C. If the spill is on the skin, wash the affected parts thoroughly with water or appropriate solution.
D. If the spill is on clothing, remove and discard the contaminated clothing immediately.
E. Shut off the power to all fans and air circulators.
F. Vacate the room
G. Notify the Hazardous Chemical Safety Officer as soon as possible and include identification of material involved.
H. Decontaminate personnel involved; obtain medical aid, if necessary.
I. Decontaminate the area; personnel involved in decontamination must be adequately qualified and protected.
J. Spills should be inactivated in situ or be absorbed by any appropriate method; check up with swipe tests or fluorescence tests.
K. Monitor all persons involved in the spill and clean-up.
L. Permit no one to resume work in the area without the approval of the Hazardous Chemical Safety Officer.
M. Prepare and submit to the Hazardous Chemical Safety Officer a complete history of the accident and subsequent remedial actions on an Incident/Near Miss Report.

III. Accidents Involving Toxic Dusts, Mist, Fumes, Organic Vapors and Gases.

A. Anyone involved in an accident must notify all other persons to vacate the area immediately.
B. Refrain from breathing as much as possible; close the escape valves on the container leaking the contaminant. Use a respirator if necessary.
C. Vacate the room and, if necessary, activate the fire alarm to vacate the building.
D. Notify the Hazardous Chemical Safety Officer.
E. Ascertain that all doors to the room are closed; post conspicuous warnings or guards to prevent accidental opening of the doors or entry.
F. Monitor all persons suspected of contamination.
G. Proceed with decontamination of personnel.
H. Report at once all known or suspected inhalations of toxic materials.
I. Evaluate the hazard and the necessary safety devices for safe re-entry.
J. Determine the cause of contamination and rectify the condition prior to the start of any area decontamination operations.
K. Establish a plan of operation and begin decontamination of the area. Check adequacy of clean-up with swipe tests or fluorescence tests.
L. Perform an air survey of the area before permitting normal work to be resumed.
M. Prepare and submit to the Hazardous Chemical Safety Officer a complete history of the accident and subsequent remedial actions on an Incident/Near Miss Report.

IV. Fires or Other Major Emergencies

A. Anyone involved in a fire or other emergency must notify all other persons in the room and building at once.
B. Contact the Fire Department and Safety personnel including the Hazardous Chemical Safety Officer.
C. Extinguishing the fire may be attempted if a toxic hazard is imminent, or if the fire is small in size.
D. Restrict firefighting and other emergency activities to the guidelines and rules prescribed by the Hazardous Chemical Safety Officer.
E. Monitor all persons involved in combating the emergency.
F. Following the emergency, monitor the area and determine the protective devices required for safe decontamination.
G. Establish a plan of operation and begin decontamination in the area.
H. Permit no one to return to work without the approval of the Hazardous Chemical Safety Officer.
I. Prepare and submit to the Hazardous Chemical Safety Officer a complete history of the emergency and subsequent remedial or protective actions on an Incident/Near Miss Report.

V. First Aid

Report all hazardous material accidents with possible health effects, wounds, ingestion, inhalation, etc., to a physician or other professional medical person immediately; use extreme care in providing emergency comfort or first aid treatment, so as to avoid aggravating the injury. (Washing under running water may be attempted.)

A. For wounds:
    1. Wash wound or affected area immediately under running water, spreading the wound sufficiently to allow good rinsing.
    2. Call or take the injured person to a physician or other person qualified to treat toxic injuries.
    3. Retrieve the Safety Data Sheets for chemicals involved and bring with patient to

the Medical Provider.

4. Employ appropriate measures to prohibit the spread of toxic material by the injured.
5. Permit no person injured by toxic substances to return to work without the approval of the physician and the Hazardous Chemical Safety Officer.
6. Prepare accident and injury reports as required for the Hazardous Chemical Safety Officer and the Personnel Office.
7. Prepare and submit to the Hazardous Chemical Safety Officer a complete history of the accident and subsequent actions on an Incident/Near Miss Report.

Appendix 2 - Chemical Waste Removal

I. Requesting Chemical Waste Removal

To request the pickup of hazardous chemical waste, the Principal Investigator or other individual designated by the Principal Investigator shall call the Hazardous Chemical Safety Office (1-7759).

The following procedures must be completed before a chemical waste pickup will be made:

A. All waste containers must be tightly closed. Screw-type closures (caps or lids) are required on all containers. Corks, cotton plugs, plastic sheeting, etc., are not acceptable for bottles which contain liquids. Flasks and beakers are not acceptable containers for liquid or solid waste. Place liquid and solid wastes into plastic jugs supplied by the Safety Office. Make sure chemicals are compatible before mixing. Waste containers must be labeled with contents, even during use.

B. Chemicals that are in their original containers and separated into the following categories: (A) Acid, (C) Caustic, (F) Flammable, (H) Halogenated, (O) Oxidizer, (T) Toxic, (W) Water reactive. Solid waste should be placed in boxes provided by the Safety Office so that they can be easily carried by hand. Chemicals which have the potential to react with each other should not be packed in the same box (e.g., chlorates with ammonium salts, acids with bases, cyanides with acids, etc.).

C. An NDSU Hazardous Waste Form must be completed for each container of waste. The form (see Appendix 4) requires entries for the Principal Investigator, building, department, room number, telephone number, date, classification of waste, specific contents and amount.

Appendix 3 - Definitions

I. Definition of Hazardous Waste

A. Characteristics of Hazardous Waste (40 CFR, Part 261, Subpart C)
Using the Environmental Protection Agency criteria, a solid waste (including solid, liquid, semisolid, or contained gaseous materials) is considered a hazardous waste if it is listed by EPA in 40 CFR Part 261, Subpart D, or exhibits any of the following four characteristics.

1. Ignitability/Flammability (Environmental Protection Agency Identification No.-D001).

A. It is a liquid and has a flash point less than 60o C (140o F) as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in ASTM Standard D-93-79 or D-93-80.

B. It is not a liquid and is capable, under standard temperature and pressure, of causing a fire through friction, absorption of moisture or spontaneous chemical changes, and when ignited, burns so vigorously and persistently that it creates a hazard.

C. It is an ignitable compressed gas or an oxidizer as defined in the Code of Federal Regulations.

2. Corrosivity (Environmental Protection Agency Identification No.-D002).

A. It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5 or corrodes steel at a rate of 6.35 millimeters per year at a test temperature of 55o C.

B. A solid waste that exhibits the characteristics of corrosivity has the EPA Hazardous Waste Number of D002.

3. Reactivity (Environmental Protection Agency Identification No.-D003).

A. It is normally unstable and readily undergoes violent change without detonating.

B. It reacts violently with water.

C. It forms potentially explosive mixtures with water.

D. When mixed with water, it generates toxic fumes, gases, or vapors in a quantity sufficient to present a danger to human health or environment.

E. It is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.

4. Carcinogenic Chemicals

Lists are available from the International Agency for Research on Cancer and/or in the U.S. Department of Health and Human Services. SDS's are required to contain notification if a chemical is a carcinogen or suspected carcinogen.

The following list was compiled from chemicals identified by the International Agency for Research on Cancer and/or in the U.S. Department of Health and Human Services Third Annual Report on Carcinogens as showing sufficient evidence from epidemiological studies to support a casual association between exposure and cancer. This is a list of known carcinogens, as opposed to suspected carcinogens.

2-Acetylaminofluorene	Coke oven emissions
4-Aminobiphenyl	Cyclophosphamide
o-Anisidine	Di(2,3-epoxypropyl) Ether (DGE)
Asbestos	Diethylstilbestrol (DES)
Azathioprine	Hydrazine
4-Butanediol Dimethonesulfonate (Myleran)	Melphalan
Benzene	Methoxsalen with Ultra-Violet A Therapy (PUVA)
Benz(a)anthracene	Mustard gas
Benzidine	2-Naphthylamine
Benzo(a)pyrene	5-Nitro-o-anisidine
N,N-bis(2-chloroethyl)-2-naphthylamine (chlornaphazine)	Nitroso-organic compounds
	Polychlorinated Biphenyls (PCBs)
	Tetrachlorodibenzo-p-dioxin (TCDD)
Bis(chloromethyl)ether (BCME) and technical grade chloromethyl methyl ether (CMME)	Thorium dioxide
	Treosulphan
1,3-Butadiene	Vinyl chloride and/or vinyl bromide
Chlorambucil	
Chromium and certain chromium compounds	

B. Special Materials

There are specific types of waste that require special handling procedures due to restrictive packaging and disposal regulations. The following types of material must be handled by the Hazardous Chemical Safety Office.

1. Pesticides

Pesticides are controlled by the Environmental Protection Agency (and other agencies), therefore, organic and inorganic types should be handled by the Hazardous Chemical Safety Officer. All containers must be labeled indicating both the trade name and the chemical name of the active ingredient. Examples include insecticides, herbicides, fungicides, etc.

2. Carcinogens

a. All carcinogens above must be handled by the Hazardous Chemical Safety Office. Containers should be placed in plastic bags and labeled carcinogenic prior to pick up.

3. Toxic

a. Toxic is defined by OSHA 29 CFR 1910.1200 App A as a chemical which falls in any of these three categories:

- A chemical that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
- A chemical that has a median lethal dose (LD50) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
- A chemical that has a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

4. Highly toxic

a. Highly toxic is defined by OSHA as:

(1) A chemical that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(2) A chemical that has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(3) A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

5. Peroxidizable Chemicals

a. Peroxidizable chemicals such as those listed below should be dated upon receipt. Storage and use should be limited to the time indicated for each class or list. Containers which show signs of iron oxide or copper oxide should be handled with extra precaution since many metal oxides promote peroxide formation.

The most hazardous compounds - those that form peroxides without being concentrated, which can accumulate a hazardous level of peroxides simply on storage after exposure to air - are in List I. Compounds forming peroxide that is hazardous only when concentrated are in List II. List III consists of vinyl monomers that may form peroxides which can initiate explosives polymerization of the monomers. These lists are not exhaustive.

List I	List II	List III
12 Months	18 Months	18 Months
Peroxide Hazard on Storage	Peroxide Hazard on Concentration	Hazard Due to Peroxide Initiation of Polymerization*
Diethyl ether Isopropyl ether Divinyl acetylene Vinylidene chloride Ethylene glycol Di - Methyl ether (Glyme) Dicyclopentadiene Diacetylene Methyl acetylene Cumene Tetrahydronaphthalene Cyclohexene	Acetal Dioxane Tetrahydrofuran Vinyl ethers Vinyl acetylene Vinyl acetate Vinyl chloride Vinyl pyridine Chlorobutadiene (Chloroprene) Methylcyclopentane	Styrene Butadiene Tetrafluoroethylene Chlorotrifluoroethylene

*When stored as a liquid, the peroxide-forming potential increases and certain of these monomers (especially butadiene, chloroprene, and tetrafluoroethylene) should be considered as List I compounds.

6. Polyhalogenated Biphenyls

a. PCB (Polychlorinated biphenyl), PBB (Polybrominated biphenyl), and chemically similar compounds.

7. Asbestos

a. It should be well sealed in the container, which should in turn be placed in a plastic bag and sealed.

8. Miscellaneous material

a. The following materials require special handling procedures in order to comply with Department of Transportation and Environmental Protection Agency packaging and disposal regulations.

(1) Explosives (as defined by the Bureau of Alcohol, Tobacco, and Firearms).
(2) Shock sensitive material
(3) Cylinders (gas or liquid)

Appendix 4 - Hazardous Waste Form

NDSU NORTH DAKOTA STATE UNIVERSITY | Hazardous Waste | Waste Ticket No. 105060

Circle Bld/Hall name or write in neatly below

Dunbar Ladd R1 R1A R2 Sudro CIE Hill HillPrep
ABEN Askanase Batcheller Dolve Ehly ECE Geoscience
Harris Hultz Loftsgard QBB Renaissance Stevens
VanEs VDL ServiceCenter PilotPlant Waldron Walster

Start Date: ___/___/___.

Bld/Hall: _____ **Rm/Lab#:** _____ End/Full Date: ___/___/___.

Your Email (Print Neatly): _____ **@ndsu.edu**

Your Cell Phone: (_____) _____ - _____ Please fill in **all** Shaded Sections

PI Email (Print Neatly): _____ **@ndsu.edu**

Hazard Class: Acid **A**, Caustic **C**, Flammable **F**, Halogenated **H**, Oxidixer **O**, Toxic **T**, Water Reactive **W**

Hazard Class	Hazardous Chemical Waste Substance	Amount (Mass, Volume or %)

Comments/Additional Information on Substance(s):
Including, But Not Limited To: Shock Sensitive, Storage or Cleanout issues, Strong Stench/Odor, Lacrimation/Rear Shedding, Refrigerate Temperature Sensitive, Carcinogenic, Teratogenic or Mutagenic, etc.

Total Vol. or Mass: _____

When container is ready, **IMMEDIATELY** call 231-7759 for container pickup.

Safety Office Use Only

Initials: _____.

Storage Class
A C F H O T W

Waste Phase
Liquid Solid

Pickup Date: ___/___/___.

Appendix 5 - Toxins, Select Agents and Export Items

The following categories of toxins, select agents and export items require additional procedures and government enforcement to ensure faculty, staff and students are prevented from exposure and antagonists of the United States of America do not have access to these toxins, select agents and export items.

If planning on using any materials with the following characteristics contact the Safety Office for additional guidance and requirements:

I. Highly toxic substances

a. A Gas with a LC50 <= 200 mL/m3 Inhalation*
b. A Liquid or Solid with a LD50 <= 5 mg/kg Oral**
c. A Material with a LD50 <= 40 mg/kg in Dermal Contact**
d. A Dust or Mist with a LD50 <= 0.5 mg/L**

II. Select agents and toxins

a. Listed on either the CDC HHS or USDA Select Agents & Toxins List.***
b. Refer to web link below for complete list.

III. Export controlled items

a. US Department of Commerce: EAR****
b. US Department of State: ITAR*****
c. Refer to web links below for complete listing.

IV. References:

*Department of Transportation (DOT) 49 CFR 173.116(a) and DOT 49 CFR 173.115(c)(2)
Website links:
http://edocket.access.gpo.gov/cfr_2003/octqtr/pdf/49cfr173.115.pdf
http://edocket.access.gpo.gov/cfr_2003/octqtr/pdf/49cfr173.116.pdf

**Department of Transportation (DOT) 49 CFR 173.133(a)(1)
Website link: http://edocket.access.gpo.gov/cfr_2003/octqtr/pdf/49cfr173.133.pdf

***Centers for Disease Control and Prevention (CDC) 42 CFR part 73.3
and US Department of Agriculture (USDA) 9 CFR part 121.
Website links: https://www.selectagents.gov/SelectAgentsandToxinsList.html

****Export Administration Regulations (EAR)
Website link: https://www.export.gov/article?id=Webinars-Export-Admin-Regs

***** International Traffic in Arms Regulations (ITAR)
Website link:
https://www.pmddtc.state.gov/ddtc_public?id=ddtc_kb_article_page&sys_id=24d528fddbfc930044f9ff621f961987