

## TABLE OF CONTENTS

1.0	PURPOSE.....	5
1.1	Scope.....	6
1.2	Policy .....	7
1.3	Definitions.....	7
2.0	REQUIREMENTS.....	8
3.0	RESPONSIBILITIES .....	8
3.1	222-S Laboratory Manager and ATL Laboratory Manager .....	8
3.2	First-Line Laboratory Managers .....	8
3.3	Laboratory Employees .....	9
3.4	Chemical Hygiene Officer .....	9
3.5	WRPS Chemical Hygiene Subject Matter Expert (SME).....	10
3.6	Chemical Hygiene Committee.....	10
3.7	Industrial Hygiene (IH) Representative(s).....	11
4.0	PROCEDURE.....	12
4.1	Assess the Risk of Exposure and Chemical Reactions .....	12
5.0	CONTROL STRATEGIES.....	13
5.1	Engineering Controls .....	14
5.2	Chemical Hygiene Practices .....	15
5.3	Air Monitoring Requirements.....	16
5.4	Occupational Exposure Limits.....	17
5.5	Personnel Protective Equipment (PPE) .....	17
5.6	Housekeeping.....	20
6.0	LABORATORY-USE CHEMICALS .....	21
6.1	Identification of Chemical Hazards .....	21
6.2	Recognizing the Signs and Symptoms of Exposure .....	21
7.0	WORKING WITH PARTICULARLY HAZARDOUS SUBSTANCES .....	22
7.1	General Requirements.....	22
7.2	Use of Containment Devices, Such as Fume Hoods or Gloveboxes .....	22
7.3	Establishment of a Designated Area.....	23
7.4	Safe Removal of Contaminated Waste .....	24
7.5	Contamination Protection and Decontamination .....	24
7.6	Additional Controls.....	26
8.0	CHEMICAL PROCUREMENT, STORAGE, AND DISTRIBUTION.....	27
8.1	Procurement of Chemicals.....	27
8.2	Receipt of Chemicals .....	28
8.3	Storage of Chemicals .....	28
8.4	Distribution and Movement of Chemicals.....	29

9.0	SIGNS AND LABELS .....	29
9.1	Signs.....	29
9.2	Labels.....	29
10.0	WASTE GENERATION .....	30
11.0	EMPLOYEE INFORMATION AND TRAINING .....	31
12.0	MEDICAL CONSULTATION AND EXAMINATIONS .....	31
12.1	Conditions Warranting Additional Medical Consultation or Examinations.....	31
12.2	Information Provided to Physician .....	32
12.3	Physician Response Requirements .....	32
13.0	SPIILLS AND ACCIDENTS.....	33
13.1	Emergency Plan Requirements.....	33
13.2	Spills .....	33
13.3	Methods to Detect Spills or Releases.....	34
14.0	CORRECTIVE ACTION .....	34
15.0	ANNUAL REVIEW .....	34
15.1	Annual Review Elements.....	34
16.0	FORMS .....	34
17.0	RECORDS .....	35
18.0	SOURCES.....	35
18.1	Requirements .....	35
18.2	References.....	35

**TABLE OF APPENDICES**

Appendix A.	Hand Protection.....	39
Appendix B.	Additional Information.....	41

**TABLE OF TABLES**

Table 1. OSHA Regulated Carcinogens ..... 23  
Table 2. Substance-Specific Contamination Control Requirements..... 25  
Table 3. Hand Protection, Chemical Resistance Information..... 40

**Revision Status**

Revision	Effective Date	Description
17	01/23/2013	Major revision. The completion of the required annual review of the procedure by the 222-S Laboratory Complex Chemical Hygiene Committee resulted in updates due to changes in procedures of both WRPS and ATL. To reflect changes being implemented as a result of an update to 29 CFR 1910.1200 from Material Safety Data Sheet to just Safety Data Sheet, all references to MSDS were replaced with MSDS/SDS. A number of editorial changes were made to improve clarity and consistency in terminology and descriptions. References and direction were added to the section identifying inspection requirements. Where specific implementing direction is also incorporated in an existing operating procedure the direction was replaced by a reference to the applicable procedure. Footwear protection requirements changed to reflect changes to TFC-ESHQ-S_IS-C-02. Section 7.5, Table 2. Title corrected to reflect actual OSHA relationship. Concentration values replaced by CAS numbers as more applicable to the use of the table. Specific direction on segregation practices removed (being added to ATS-LO-150-063. NFPA citations moved to references because adherence to these standards are driven by applicable regulations. Added link in Att. B to OSHA Hazard Communication –GHS information. Replaced Hanford health care provider physician’s with examining physician’s.
D-1	10/31/2013	Minor Technical Revision. The completion of the required annual review of the procedure by the 222-S Laboratory Complex Chemical Hygiene Committee resulted in minor changes to provide clarification, editorial corrections and the addition of a reference to ATL-MP-1043.
D-2	06/09/2014	Section 5.5 - Added direction to wear long sleeves as minimum arm protection when working with or handling hazardous chemicals.  Appendix B - Added link to the OSHA Occupational Chemical Database tool.  Additional reviewer: F for both companies. Per APPROVALS and COMMENTS .xml file JR Keene reviewed this procedure.

All trademarks and registered trademarks are the property of their respective owners.

## 1.0 PURPOSE

This chemical hygiene plan fulfills the requirements of Occupational Safety and Health Standard 29 Code of Federal Regulations (CFR) Part 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*. This plan addresses the following required elements as specified in the standard:

- Scope and Application
- Definitions
- Permissible Exposure Limits
- Employee Exposure Determination
- Chemical Hygiene Plan
- Employee Information and Training
- Medical Consultation and Medical Examinations
- Hazard Identification
- Use of Respirators
- Particularly Hazardous Substances
- Recordkeeping

This procedure also implements the essential elements of Integrated Environmental, Safety, and Health Management System (ISMS), Core Function 2 "Identify the Hazards" and Core Function 3, "Develop and Implement Hazard Controls" as referenced in:

- (Advanced Technologies and Laboratories International, Inc.[ATL] Employees) ATL-MP-1009, *Integrated Environmental, Safety, and Health Management System Description for the 222-S Laboratory Analytical Services and Testing Contractor (ISMS)*.
- (Washington River Protection Solutions, LLC [WRPS] Employees) RPP-MP-003, *Integrated Environment, Safety, and Health Management System Description for the Tank Operations Contractor*.

Steps in this procedure may be performed in any order.

## 1.1 Scope

This chemical hygiene plan applies to all personnel who are engaged in any activities of laboratory use of chemicals at the 222-S Laboratory Complex, regardless of company affiliation.

For the purpose of this plan, *chemical* means any element, chemical compound, or mixture of elements and/or compounds that is hazardous according to the definitions of the Occupational Safety and Health Administration (OSHA), the National Fire Protection Association (NFPA), as addressed in applicable NFPA documents including but not limited to the NFPA 1, *Fire Code*, NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals* and NFPA 704, *Standard System for the Identification of Hazards of the Materials for Emergency Response*.

At the 222-S Laboratory Complex, ATL provides analytical services and testing, and WRPS provides Process Chemistry/Special Analytical Services/Organic Studies (PC/SAS/OS) services, laboratory infrastructure, maintenance, and facility operations support as the Tank Operations Contractor for the Department of Energy's (DOE) Office of River Protection. 29633-BOP-AIA-0001, *Administrative Interface Agreement between Washington River Protection Solutions, LLC. (WRPS) and Advanced Technologies and Laboratories International, Inc. (ATL) for 222-S Laboratory Analytical Services and Testing*, provide a more detailed description of the interface agreements between ATL and WRPS, and where each contractor has different policies or procedures, the responsible contractor will be specifically addressed.

The 222-S Laboratory Complex Chemical Hygiene Plan is available on the ATL and WRPS Procedures web pages, which is accessible from both the ATL and WRPS main web pages. Both contractors' main web pages are accessible from the Department of Energy's Hanford Intranet web page (<http://www.rl.gov>).

Activities considered "laboratory use of chemicals" include chemical manipulations carried out on a laboratory scale and procedures or test plans using multiple chemicals in a laboratory setting.

Effective 5/26/2012, per OSHA direction in 29 CFR 1910.1200, manufacturers will begin replacing Material Safety Data Sheets (MSDS) with Globally Harmonized System-Safety Data Sheets (GHS-SDSs). During the implementation period, manufacturers are allowed to use either format. The term MSDS has been replaced with GHS-SDS/MSDS to reflect the change.

The OSHA 29 CFR 1910.1450 applies to all employees engaged in the laboratory use of chemicals and, where it applies, supersedes all other OSHA health standards in 29 Code of Federal Regulations (CFR) Part 1910, Subpart Z, *Toxic and Hazardous Substances*, except for the following.

- The lower of OSHA's Permissible Exposure Limits (PEL) or American Conference of Governmental Industrial Hygienists (ACGIH) *Threshold Limit Values (TLV) for Chemical Substances and Physical Agents, Biological Exposure Indices*, shall not be exceeded without additional protective measures (i.e., personnel protective equipment [PPE]).
- Where the action level is routinely exceeded, the exposure monitoring and medical surveillance requirements of the substance-specific OSHA standard shall apply if a separate standard exists.

- Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.
- If a chemical substance is produced for a user outside of the laboratory, compliance with the *Hazard Communication Standard* (29 CFR 1910.1200), including the requirements for preparation of GHS-SDSs/MSDSs and labeling, shall be ensured.

The chemical hygiene plan does not apply to procedures or test plans that are part of a production process, maintenance activities, or operations-related activities that do not directly support laboratory analytical operations, even if such activities occur in the laboratory. When handling chemicals related to the above listed activities, refer to TFC-ESHQ-S\_IH-C-02, *Hazard Communication*, for applicable requirements.

## **1.2 Policy**

The 222-S Laboratory Complex policy is to provide a work place that is both safe and healthy for the employees and to prevent uncontrolled releases of chemicals to the environment.

The 222-S Laboratory Complex complies with OSHA, DOE orders, and Washington State Department of Ecology regulations, standards, and guidelines for safety in its laboratories, research facilities, and activities. The complex strives to keep employee exposures to chemicals as low as reasonably possible and below the occupational exposure limits.

Safety and health policies can be found at:

- (ATL Employees) ATL-POL-011, *ATL Health and Safety Policy*
- (ATL Employees) ATL-MP-1028, *ATL Health and Safety Plan*
- (ATL Employees) ATL-MP-1037, *Worker Safety and Health Program*
- (WRPS Employees) TFC-POL-14, *WRPS Safety and Occupational Health*
- (WRPS Employees) TFC-PLN-01, *Integrated Environment, Safety, and Health Management System Plan*
- (WRPS Employees) TFC-PLN-47, *Worker Safety and Health Program*

## **1.3 Definitions**

Per 29 CFR 1910.1450, laboratory use of hazardous chemicals means handling or use of chemicals in which all of the following conditions are met:

- Chemical manipulations are carried out on a laboratory scale;
- Multiple chemical procedures or chemicals are used;
- The procedures involved are not part of a production process, or in any way simulate a production process; and
- Protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

See ATS-GD-1055, *Common Definitions Associated with Chemical Hygiene and Chemical Management*, for additional chemical hygiene plan related definitions.

## **2.0 REQUIREMENTS**

Compliance with OSHA Standard 29 CFR Part 1910 is required by 10 CFR Part 851, *Worker Safety and Health Program*.

## **3.0 RESPONSIBILITIES**

### **3.1 222-S Laboratory Manager and ATL Laboratory Manager**

The 222-S Laboratory Manager/delegate and the ATL Laboratory Manager/delegate are responsible for providing a safe and healthy working environment for employees. This responsibility includes developing and implementing this chemical hygiene plan and overseeing programs to ensure that this plan has continued management support and adequate resources.

The 222-S Laboratory Manager (or delegate) and the ATL Laboratory Manager (or delegate) responsibilities include the following.

- 3.1.1 Appoint Chemical Hygiene Officer (CHO).
- 3.1.2 Review laboratory activities and research operations to determine which jobs and procedures must be revised to incorporate safety and chemical hygiene measures for employee protection.
- 3.1.3 Ensure that management personnel are following safety and health policies.
- 3.1.4 Provide and document training of employees for the chemical hygiene plan and the safe handling of chemicals.

### **3.2 First-Line Laboratory Managers**

The first-line laboratory manager (or delegate) responsibilities include the following.

- 3.2.1 Ensure that operations involving laboratory-use chemicals are controlled by a procedure or test plan according to the requirements of Section 4.0.
- 3.2.2 Ensure work areas are inspected at least quarterly in accordance with ATS-310, Section 9.2, "Safety Inspection Programs":
- 3.2.3 Ensure employees are trained to the chemical hygiene plan and know how to safely handle chemicals before work begins.
- 3.2.4 Identify appropriate chemical storage locations.
- 3.2.5 Review and update laboratory procedures and test plans to incorporate appropriate safety and health measures, as applicable to the first-line laboratory manager's organization.
- 3.2.6 Be knowledgeable of the current requirements concerning regulated substances.
- 3.2.7 Ensure protective equipment is available and processes are in place to ensure it is in working order.

### 3.3 Laboratory Employees

Laboratory employees have the following responsibilities.

- 3.3.1 Follow approved laboratory procedures or test plans (see Section 4.0 for additional information on laboratory procedures).
- 3.3.2 Follow the requirements of this chemical hygiene plan.

*NOTE – Labeling in accordance with ATS-LO-120-007, is not required on secondary containers of chemicals intended for use by laboratory personnel if the container is not left unattended, although labeling these containers is a good practice.*

- 3.3.3 Maintain labels on all containers of chemicals as required by ATS-LO-120-007.
- 3.3.4 Know how to access and use GHS-SDSs/MSDSs (Hanford website is: <http://www7.rl.gov/msds/>).
- 3.3.5 Know emergency procedures, and participate in emergency drills.
- 3.3.6 Inform manager of any potentially unsafe acts or conditions, including laboratory ventilation concerns, changed labels, or additional equipment needed for working safely.
- 3.3.7 Immediately inform manager of any symptoms or signs of suspect exposure to chemicals.

### 3.4 Chemical Hygiene Officer

A single CHO is appointed to serve for the entire 222-S Laboratory Complex. Per 29633-BOP-AIA-0001, ATL provides Chemical Hygiene support.

The CHO has the following responsibilities through direct responsibilities or supporting contracts:

- 3.4.1 Provide technical assistance and guidance to all levels of management within both WRPS, as requested, and ATL in developing and implementing laboratory safety and chemical hygiene practices. Assist technical authorities to incorporate these practices into procedures, work plans, test plans, and other operations.
- 3.4.2 Know the current requirements for chemical management, laboratory safety, chemical hygiene, labeling and storage of chemicals, waste management, and emergency response to chemical splashes or spills.
- 3.4.3 Ensure a list of Particularly Hazardous Substances is available on the 222-S Laboratory/ATL webpage. This list shall be reviewed and updated as needed, at least annually.
- 3.4.4 Ensure a list of Reactive and Time-Sensitive Chemicals is available on the 222-S Laboratory/ATL webpage. Ensure the list is reviewed and updated as needed, at least annually, in accordance with the requirements of ATS-LO-150-062, *Management of Reactive and Time-Sensitive Chemicals in the Laboratory*.

- 3.4.5 Chair the Chemical Hygiene Committee, and seek ways to improve the chemical hygiene program.
- 3.4.6 Call periodic meetings of the Chemical Hygiene Committee at least annually, more frequently, if needed.
- 3.4.7 Maintain Chemical Hygiene Committee documentation (record material).
- 3.4.8 Ensure chemicals are managed in accordance with requirements of:
  - *ATS-LO-150-063, Chemical Management for the 222-S Laboratory Complex*
  - 29633-BOP-AIA-0001
- 3.4.9 Ensure that appropriate assessments are performed and documented in accordance with the requirements of:
  - *(ATL Employees) ATL-MP-1020, Assessment Program*
  - *(WRPS Employees) ATS-310, Section 1.39, "Assessment Program."*

### **3.5 WRPS Chemical Hygiene Subject Matter Expert (SME)**

The WRPS Chemical Hygiene SME has the following responsibilities:

- 3.5.1 Provide oversight to the 222-S Laboratory Complex Chemical Hygiene Plan and supporting contracts for WRPS.
- 3.5.2 Ensure consistency between company chemical management procedures and this chemical hygiene plan.
- 3.5.3 Participate on the Chemical Hygiene Committee.

### **3.6 Chemical Hygiene Committee**

The Chemical Hygiene Committee has the following responsibilities.

- 3.6.1 Ensure the WRPS/ATL training program(s) adequately covers the requirements of this chemical hygiene plan at the 222-S Laboratory.
- 3.6.2 Evaluate laboratory practices and policies for compliance with this chemical hygiene plan and governing standards.
- 3.6.3 Publish recommendations or findings to management in order to improve or correct the program.
- 3.6.4 Complete the annual review of the chemical hygiene plan, and update as needed.

3.6.5 The Chemical Hygiene Committee shall be made up of the following personnel:

- CHO (Chair)
- WRPS Chemical Hygiene SME
- Industrial Hygiene Representative
- Environmental Compliance Representative
- Analytical Chemistry First-Line Manager/Team Lead
- Chemist
- Chemical Technologist
- Radiological Controls Representative
- Training Representative
- Other personnel as necessary to address chemical hygiene plan issues

### **3.7 Industrial Hygiene (IH) Representative(s)**

The industrial hygiene representatives are the ATL and/or WRPS Safety and Health representatives who are responsible for the following duties at the laboratory. 29633-BOP-AIA-0001 provides additional details on each company's responsibilities.

- 3.7.1 Support the CHO and the Chemical Hygiene Committee.
- 3.7.2 Review and approve laboratory technical procedures, as required.
- 3.7.3 Initiate exposure monitoring if there is reason to believe the occupational exposure levels routinely exceed the action level (see Section 5.3).
- 3.7.4 Approve new chemical purchases. Provide special labeling or hazard control information (e.g., carcinogen), as needed.
- 3.7.5 Review annually the 222-S Hazards and Controls Inventory, update as appropriate.
- 3.7.6 Review and approve the hazard analyses for laboratory procedures and test plans, as required.

## 4.0 PROCEDURE

No one shall perform chemical-related laboratory operations in the 222-S Laboratory Complex unless covered by an approved laboratory procedure or test plan.

Technical procedures, which are located on the 222-S Laboratory/ATL Procedures web pages, shall be developed, maintained, and controlled according to the requirements of:

- (ATL Employees) ATL-312, Section 11.16, “Technical Procedure Control and Use”
- (WRPS Employees) ATS-310, Section 11.16, “Technical Procedure Control Process.”

Test plans shall be developed and authorized in accordance with the requirements of:

- (ATL Employees) ATL-312, Section 11.16
- (WRPS Employees) ATS-310, Section 1.9, “Laboratory Test Planning.”

### 4.1 Assess the Risk of Exposure and Chemical Reactions

Plans and procedures that include the use of laboratory chemicals shall use the following steps to assess the risk of exposure and chemical reactions. These are the minimum evaluation requirements. For occupational carcinogens, reproductive toxins, and highly toxic chemicals, the requirements in Section 7.0 must also be addressed.

- 4.1.1 Identify both the initial chemicals and, where feasible, the chemical products and the circumstances of use in the planned chemical process, as required by:
  - (ATL Employees) ATL-312, Section 11.16, “Procedure Control and Use”
  - (WRPS Employees) ATS-310, Section 11.16.1, “222-S Laboratory Technical Procedure Writing and Formatting Guide”
  - (WRPS Employees) ATS-310, Section 1.9.
- 4.1.2 Consult sources of chemical hazard information, including, but not limited to, the GHS-SDS/MSDS. Other sources of chemical hazard information are:
  - *Bretherick’s Handbook of Reactive Chemical Hazards*
  - *Sax’s Dangerous Properties of Industrial Materials*
  - *The Merck Index*
  - National Fire Protection Association (NFPA) Codes and Standards
  - National Toxicology Program, *Report on Carcinogens*.

- 4.1.3 Evaluate the potential hazards associated with the plans and procedures using the following hazard analysis tools:
- *(ATL Employees) Site Form No. A-6004-775, Laboratory Worksite Hazard Analysis.*
  - *(WRPS Employees) Site Form No. A-6004-101, WRPS Job Hazard Analysis Checklist, completed in accordance with TFC-ESHQ-S\_SAF-C-02, Job Hazard Analysis.*
- a. Evaluate potential hazards such as toxicity, flammability, corrosivity, reactivity, and instability, including possible routes of exposure
  - b. Select appropriate measures to minimize exposure and risk using the control strategies specified in Section 5.0, including the identification of any PPE.
  - c. Prepare for contingencies and emergencies that may be reasonably anticipated.
  - d. Incorporate hazard information and controls into the procedure, as needed.
  - e. Request sampling and exposure assessment from appropriate IH source for all chemicals presenting a toxicity hazard, if the potential for exposure is above the occupational exposure limits as specified in Section 5.4.
- 4.1.4 Perform waste compatibility assessment, as required by ATS-310, Section 6.4.5, “Waste Stream Fact Sheet Development and Issuance (Pre-designation of Waste).”

## 5.0 CONTROL STRATEGIES

The 222-S Laboratory has established and implemented a hazard prevention and abatement process. This process ensures all identified and potential hazards are prevented or abated in a timely manner. Controls are selected to mitigate or minimize risk of exposure to a hazard.

The hierarchy of controls that shall be used are:

- 1) Elimination or substitution of the hazards where feasible and appropriate.
- 2) Engineering controls where feasible and appropriate.
- 3) Work practices and administrative controls that limit worker exposures.
- 4) Personal protective equipment.

Appropriate controls shall be identified through the use of the hazard analyses tools in Section 4.1.3 and be incorporated into chemical and activity-specific procedures and plans. For occupational carcinogens, reproductive toxins, and highly toxic chemicals (all particularly hazardous substances), the additional controls identified in Section 7.0 must also be incorporated.

## 5.1 Engineering Controls

The primary engineering control used to minimize employee exposure to chemicals is properly designed, tested, and operating local general ventilation. Personnel shall use fume hoods, gloveboxes, or hot cells when called for by procedure, work plan, or test plan. Personnel shall not perform work in any fume hood, glovebox, or hot cell that does not meet established minimum operating parameters. Parameters are identified in activity or facility-specific procedures.

In general, air flow patterns within the laboratory provide a flow of air in occupied areas to direct contaminants away from the breathing zone of personnel. Specifically, the air flow is designed to flow from the corridors into laboratories and exhaust through the fume hoods. The 222-S Laboratory ventilation system is designed to change laboratory room air a minimum of seven times per hour.

### 5.1.1 Laboratory Fume Hoods

The laboratory fume hood ventilation system operates to maintain the average exhaust flow velocity at the face of laboratory fume hoods, in accordance with guidance from ACGIH. The 222-S Laboratory fume hood performance testing program is documented in RPP-40939, *222-S Laboratory Fume Hood Performance Testing Program*. It outlines testing requirements and frequency for the 222-S Laboratory. Formal scheduling and tracking systems are used to document appropriate testing. RPP-40939 also identifies the process to identify specific standards and requirements applicable to evaluating new or upgraded equipment.

To maintain maximum efficiency of the fume hood:

- a. Ensure the hood sash is positioned at the identified height before beginning work, unless otherwise approved.
- b. Verify the proper direction and intensity of air flow.
- c. Ensure the requirements for the usage of laboratory fume hoods located within the radiological controlled areas are followed before starting any work. The radiological laboratory fume-hood use procedure is:
  - ATS-LO-161-003, *Fume Hood Use in the 222-S Laboratory*
- d. Place chemicals and apparatus at least 6 inches behind the face of the hood, when possible. Quantitative fume hood containment tests reveal that the concentration of contaminants in the worker's breathing zone can be 300 times higher from a source located at the front of the hood than from a source located at least 6 inches back.
- e. Avoid swift arm and body movements in front of or inside the hood. These actions may increase turbulence and reduce the effectiveness of fume hood containment.
- f. When possible, place equipment as far back into the hood as practical without blocking the bottom baffle.

- g. Minimize equipment, chemicals, and waste containers inside the hood, as practical.
- h. When possible, position yourself so the hood sash is between your face/upper body and the work being performed. The sash is the primary barrier preventing personal contact with a spill or splash.
- i. Minimize foot traffic past the face of the hood. Wakes or vortices from behind a person who is walking by can overcome the fume hood face velocity and pull contaminants out of the hood.
- j. When possible to safely do so, separate and elevate each instrument in the hood by using blocks or racks so that air can flow easily around all apparatus.

#### 5.1.2 Hot Cells and Gloveboxes

Hot cell and glovebox ventilation operate to provide a differential pressure between the room and the work process or operation. Differential pressures and air flows should be evaluated every three months to verify operating parameters.

## 5.2 Chemical Hygiene Practices

- 5.2.1 Follow approved procedures or test plans.
- 5.2.2 Know the location of water for flushing, in case of exposure to hazardous materials. Locations of water include, but are not limited to, safety showers, eyewash stations, room sinks, etc.
- 5.2.3 Minimize chemical exposures.
- 5.2.4 Avoid inhalation and skin contact with chemicals. Wear appropriate and approved PPE (see Section 5.5).
- 5.2.5 Avoid spreading contamination from chemicals by removing outer layer of gloves after handling chemicals.
- 5.2.6 Ensure adequate ventilation.
- 5.2.7 Do not apply mouth suction or pressure for any laboratory activity; use only the proper equipment.
- 5.2.8 To the extent feasible, use the most resistant containers, and check containers for signs of deterioration.
- 5.2.9 Use appropriate secondary containers such as chemical safety carriers when moving chemicals between storage locations or work stations.
- 5.2.10 Store chemicals in accordance with the recommendations of the manufacturer based on chemical compatibility, as specified by ATS-LO-150-063.
- 5.2.11 Know the hazards of the chemical before use. Review GHS-SDSs/MSDSs or question chemists, management or Industrial Hygienist to ensure understanding.

Appendix B lists several hyperlinks to web pages that contain additional information about chemical hazards.

- 5.2.12 DO NOT eat, smoke, or perform other personal activities in laboratory work areas. In addition, do not store food or smoking paraphernalia in laboratory work areas.
- 5.2.13 Do not bring potentially contaminated PPE, chemicals, or used glassware into areas such as offices, lunchrooms, and restrooms.
- 5.2.14 Maintain vigilance for unsafe acts and conditions.
- 5.2.15 Do not work alone within facility laboratories without the knowledge and approval of management. For additional requirements see:
- ATS-310, Section 11.12, "Shift Turnover and Minimum Staffing Guidelines for 222-S Laboratory Complex".
  - (ATL Employees) ATL-MP-1035, *Control of Working Hours and Working Alone*.
  - (WRPS Employees) TFC-ESHQ-S\_SAF-C-03, *Control of Working Hours and Working Alone*.
- 5.2.16 Working outside normal day-shift hours including administrative work requires management approval and notification of the Stationary Operating Engineer (SOE) at 373-2435 or via the Public Address System for accountability purposes. For additional information, see ATS-310, Section 11.12.
- 5.2.17 Evacuate the work area immediately if an unwanted chemical reaction occurs or if a spill/release of hazardous chemicals occurs outside engineered controls. Notify facility operations manager immediately.
- 5.2.18 Washing hands after exiting laboratory area is recommended.

### 5.3 Air Monitoring Requirements

OSHA 29 CFR 1910.1450 requires initial and periodic measurements of the employee's exposure if there is reason to believe that exposure levels for a substance routinely exceeds the action level. If an action level is not established by regulation, it will be established as 50% of the 8-hour Time Weighted Average (TWA) Occupational Exposure Limit (OEL). Management must notify the employee of the result within 15 working days after receipt of the monitoring results.

Supplemental exposure monitoring will be performed for new chemicals and/or processes not previously evaluated in RPP-33642, *Airborne Chemical Monitoring Review for 222-S Laboratory*, when there is reason to believe the change will result in an exposure level that routinely exceeds the action level of any regulated substance. Additionally, exposure monitoring may be performed to address potential transient upset conditions at the direction of facility management. Conditions under which exposure monitoring is performed are established between the safety and health representative and representatives of the various work areas. Exposure monitoring shall be conducted in accordance with:

- 29633-BOP-AIA-0001
- (WRPS Employees) TFC-PLN-34, *Industrial Hygiene Exposure Assessment Strategy*.

Exposure monitoring data shall be maintained in accordance with TFC-ESHQ-IH-STD-03, *Exposure Monitoring, Reporting, and Records Management*.

#### **5.4 Occupational Exposure Limits**

At the 222-S Laboratory Complex, the maximum airborne concentration of a chemical to which a worker may be exposed is the lower of the OSHA PELs or the ACGIH TLVs. Airborne concentrations of chemicals may be present as a vapor, mist, or dust. This approach will ensure complying with the requirements of 10 CFR 851, which sets the legal limit for DOE contractors as the lower of the PELs or TLVs.

To ensure these exposure limits are not exceeded an administrative control level of 10% of the Occupational Exposure Limit (OEL) is used to determine if further information gathering is warranted to establish frequency and extent of subsequent monitoring and, along with other methods, to decrease uncertainty of exposure assessment.

If the exposure assessment determines that any substance may exceed the action level, then additional medical surveillance, increased air monitoring (see Section 5.3), and Designated Area postings are required (see Section 7.0).

The use of an administrative control level is consistent with that taken by OSHA in the substance specific standards and is similar to the approach followed by the radiological protection program in limiting the occupational doses to as low as reasonably achievable (ALARA). This approach has been modeled after the approach described in TFC-PLN-34.

OSHA's PELs can be found in 29 CFR 1910, Subpart Z.

#### **5.5 Personnel Protective Equipment (PPE)**

Before use, PPE must be inspected by the person wearing the equipment to determine that it is the PPE designated to be used for the activity and it is functioning properly. Refer to TFC-ESHQ-S\_IS-C-02, *Personal Protective Equipment*, for specific inspection requirements. The person using the PPE must be trained to know when it is required, what PPE is required to wear, how to properly don that PPE, and any limitations of the PPE. It cannot be assumed that the PPE used to meet the requirements of a Radiological Work Permit (RWP) will meet the requirements for activities involving chemicals.

Any work or work areas requiring the use of PPE must be identified to the employee through the use of signs, procedures, or training. Procedures or test plans shall specify when specific PPE is required. Examples include but are not limited to: lab coats, aprons, boots, additional or specialized gloves, arm sleeves, and full body suits. When working with or handling hazardous chemicals in a laboratory use setting, protection of exposed skin on legs, feet, arms and hands is required. Additionally, specific laboratory locations may be posted as requiring arm and leg protection. At a minimum, arm protection will mean a long sleeved shirt.

If required for the PPE, the requirements of the American National Standards Institute (ANSI) must be met and verified by the ANSI code mark or etching.

When using chemicals, the PPE shall be based on the following:

- Hazardous properties of the chemical (i.e., is it toxic, flammable, corrosive, carcinogenic, cryogenic, etc.)
- The physical properties of chemicals (gas, liquid, solid)
- The container condition (open, closed, material on exterior of container, container integrity, etc.).

Refer to TFC-ESHQ-S\_IS-C-02, for additional requirements associated with personal protective equipment.

New types of protective equipment (e.g., gloves, face shields, etc.) not previously used at the laboratory must be evaluated and approved by both the CHO and the Industrial Hygienist prior to being placed into service.

#### 5.5.1 Eye and Face Protection Requirements

Eye protection is required for any type of work with or around chemicals, chemical products, or flying objects, such as fragments, large chips, particles, sand, or dirt. Protection, including prescription safety glasses, must conform to ANSI Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*, specifications and be marked accordingly.

ATS-310, Section 9.4, “222-S Laboratory Complex Eye Protection Requirements,” establishes the minimum level of eye protection for performing work within the 222-S Laboratory Complex and the tasks and areas where supplemental eye protection is required.

Safety glasses with side protection that provide side impact resistance are the minimum level of eye protection.

Chemical splash goggles must be worn any time there is a reasonable risk of chemical splash or spray without mitigating factors. Chemical splash goggles shall have indirect ventilation and form a tight seal to the face. Chemical splash goggles must meet ANSI Z87.1 standards. Employees may use chemical splash goggles as a substitute for safety glasses. Face shields used in conjunction with safety glasses can be substituted for chemical splash goggles.

Face shields protect the eyes, face, and neck from chemical splashes and spray as well as flying particles.

- When a face shield is required, safety glasses must also be worn.
- Face shields are necessary any time there is a need to protect the face as well as the eyes in conditions where there is a reasonable risk of splash or spray of highly corrosive or hazardous materials and there are no mitigating factors. Materials at extreme temperatures such as liquid nitrogen also require face shields.

A reasonable risk of chemical splash or spray is considered to exist under any of the following conditions:

- Working with highly corrosive substances, 29 CFR 1910.1200 defines corrosive chemicals as those chemicals that cause visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact. Chemical substances such as dilute acids, bases, oxidizers, or reducing agents with a concentration of  $\leq 5$  percent are not highly corrosive.
- Pouring any chemical from or into containers where the height of any part of this transfer is above chest level.
- Mixing liquids that can expel container contents due to a physical or chemical reaction. Examples include diluting concentrated acids into water (exothermic) or adding acids to carbonate solutions (gas evolution).
- Total hand-poured quantity is greater than 5 liters.
- Working directly with pressurized or evacuated systems where the potential for chemical splash or spray is likely to occur. Working with any pressurized or evacuated systems constructed of glass should be considered as an operation where a chemical splash or spray is likely to occur.
- Working adjacent to someone else performing any of the above tasks.

Mitigating factors:

- A hood sash is between the face and the work.
- Other engineered barriers such as splash shields or component cabinets are between the face and the work.
- If the quantity being poured is of an amount that no material would reach the face. This does not include mixing of chemicals.
- The material being used is noncorrosive, nonirritating, and not pressurized.

#### 5.5.2 Head Protection Requirements

Head protection (hard hat) shall conform to the specifications of ANSI Z89.1, *Industrial Head Protection*. Refer to TFC-ESHQ-S\_IS-C-02, for additional requirements associated with head protection.

### 5.5.3 Foot Protection Requirements

In areas where chemicals are handled, used, or stored, and protective footwear is not required for conducting laboratory work, footwear is acceptable if it meets the following criteria:

- Fully encloses the foot
- Not made of mesh
- Made of a material such as leather or a comparable synthetic material
- Has non-skid soles.

If an exposure potential exists, a chemical-resistant foot covering may be required.

Protective footwear shall always be worn when moving or carrying the following sample carriers: pigs, mini-pigs, or hedgehogs. Protective footwear shall conform to the specifications of ASTM F2413-05, *Standard Specification for Performance Requirements for Foot Protection*. Refer to TFC-ESHQ-S\_IS-C-02 for additional requirements associated with protective footwear.

### 5.5.4 Hand Protection Requirements

Hand protection shall be provided to the employee and worn when there is a potential for injury due to exposure from chemicals, severe cuts or lacerations, severe abrasions, punctures, or extreme temperatures. Selection of hand protection shall be based on published product information, dexterity requirements, and the hazard exposure potential.

See Appendix A for additional guidance in selecting gloves to be used with common laboratory chemicals.

Refer to TFC-ESHQ-S\_IS-C-02 for additional requirements associated with hand protection.

### 5.5.5 Respiratory Protection

When respiratory protection is required, the requirements and controls established in TFC-ESHQ-S\_IH-C-05, *Respiratory Protection*, shall be followed.

### 5.5.6 Additional PPE Requirements

Long hair must be restrained when working around rotating or moving equipment. Generally, it is a good practice to restrain hair when using chemicals.

## 5.6 Housekeeping

Housekeeping is essential for maintaining a safe and healthy work area. Minimize the amount of equipment, chemicals, and waste containers stored inside of the hood. Each employee is responsible for keeping his/her work area clean and neat. Housekeeping inspections will be performed in accordance with ATS-310, Section 9.2. Corrective actions will be initiated to resolve identified deficiencies. This includes avoiding any temporary blockage or interference of electrical disconnects, eyewashes, safety showers, or exit pathways.

## **6.0 LABORATORY-USE CHEMICALS**

The laboratory has over 1,000 different chemical products, which, in total, may contain more than 500 different chemical compounds. Common laboratory-use chemicals include:

- Acids, such as sulfuric acid, hydrochloric acid, acetic acid, and nitric acid.
- Bases, such as sodium hydroxide, potassium hydroxide, and ammonium hydroxide.
- Oxidizers, such as 30% hydrogen peroxide solution, fuming nitric acid, sodium persulfate, and sodium nitrate.
- Flammable liquids, such as acetonitrile, methanol, ethanol, hexane, and toluene.
- Highly toxic substances, such as sodium fluoride, potassium dichromate, sodium cyanide, and nitrogen dioxide.
- Carcinogens, such as methylene chloride, or potassium dichromate.
- Reproductive toxins, such as toluene.

Laboratory-use chemicals, including those listed above may have one or more health or physical hazards associated with them. Because the laboratory has so many different chemical products, it is not feasible to list in this document all the chemical products located at the laboratory, nor is it possible to list all the physical and health hazards or the expected signs and symptoms of exposure associated with those chemicals. The list of chemicals used at the laboratory can be found on the ATL intranet webpage.

Prior to using chemical products, personnel must ensure that they are familiar with the hazards associated with the type of chemical products being used and the expected signs or symptoms of exposure with that chemical class.

### **6.1 Identification of Chemical Hazards**

GHS-SDSs/MSDSs and chemical labels are among the best sources for identifying the hazards of laboratory chemicals. The health and physical hazards of chemicals can be identified on either the GHS-SDS/MSDS or the label through a combination of words, symbols, and numbers.

Common chemicals that can be encountered in the laboratory may include corrosive substances, flammable substances, oxidizing agents, carcinogens, reproductive toxins, and toxic substances.

See ATS-GD-1055, for definitions of various chemical hazards.

### **6.2 Recognizing the Signs and Symptoms of Exposure**

Most chemicals at the laboratory fit into specific hazard classes, which have similar signs and symptoms associated with exposure. It is not feasible to individually list the signs and symptoms of exposure to all the chemicals present at the laboratory.

Employees must recognize that common symptomatic responses of the body, such as dizziness, light-headedness, nausea, irritating or burning sensations on skin or eyes, or unusual tastes (e.g., soapy, metallic, bitter, or pungent) are not normal and could be indicators of a suspect chemical exposure.

See ATS-GD-1055 for definitions of various chemical hazards and the common signs and symptoms of exposure associated with those chemical hazards.

## **7.0 WORKING WITH PARTICULARLY HAZARDOUS SUBSTANCES**

This section identifies the requirements of laboratory-use chemicals identified by 29 CFR 1910.1450 as particularly hazardous substances. Particularly hazardous substances include highly toxic chemicals, reproductive toxins, and carcinogens. TFC-ESHQ-IH-STD-11, *Carcinogen Control*, does not apply to laboratory-use chemicals covered by this plan.

See ATS-GD-1055 for definitions of occupational carcinogens, reproductive toxins, and highly toxic chemicals.

### **7.1 General Requirements**

Procedures and test plans that include the use of occupational carcinogens, reproductive toxins, or highly toxic chemicals shall assess the potential for employee exposure. Specific consideration shall be given to the following elements, which shall be included where appropriate:

- Establishment of a Designated Area
- Use of containment devices such as fume hoods or gloveboxes
- Processes for safe removal of contaminated waste
- Decontamination processes

This evaluation is documented through the use of the Job Hazard Analysis (see Section 4.1) and with the written justification provided at the time a particularly hazardous substance is procured (see Section 8.1).

The determination of the need for control methods should be based on the following factors:

- Total amount of hazardous material to be used
- Properties (volatility, particle size)
- Proposed activity (heating, aerosol formation)
- Degree of the potential hazard

### **7.2 Use of Containment Devices, Such as Fume Hoods or Gloveboxes**

Where practicable, set up work areas in laboratory fume hoods or in other isolated systems (i.e., gloveboxes or hot cells) in order to prevent the release of material into external laboratory environment (i.e., laboratory room). No work with particularly hazardous substances shall be conducted in uncontained areas (i.e., the laboratory benchtop) if the action level, as described in Section 5.3) may be routinely exceeded or can reasonably be expected to be exceeded. All work with the following OSHA regulated carcinogens at or above the concentration listed shall be, at a minimum, in a laboratory fume hood.

Employees working with a carcinogen listed in Table 1, above the threshold concentration, shall wash their hands and arms upon completion of the assigned task or after exiting the Contamination Area (CA).

Employees working with a carcinogen listed in Table 1, above the threshold concentration in a Contamination Area (CA), shall change their outer gloves at the completion of task(s) before engaging in other activities.

**Table 1. OSHA Regulated Carcinogens**

<b>Carcinogens Listed in 29 CFR 1910.1003, "13 Carcinogens"</b>	<b>CAS<sup>1</sup> No.</b>	<b>Threshold Concentration (wt or vol)</b>
4-Nitrobiphenyl	92-93-3	0.1%
alpha-Naphthylamine	134-32-7	1.0%
methyl chloromethyl ether	107-30-2	0.1%
3,3'-Dichlorobenzidine (and its salts)	91-94-1	1.0%
bis-Chloromethyl ether	542-88-1	0.1%
beta-Naphthylamine	91-59-8	0.1%
Benzidine	92-87-5	0.1%
4-Aminodiphenyl	92-67-1	0.1%
Ethyleneimine	151-56-4	1.0%
beta-Propiolactone	57-57-8	1.0%
2-Acetylaminofluorene	53-96-3	1.0%
4-Dimethylaminoazo-benzene	60-11-7	1.0%
N-Nitrosodimethylamine	62-75-9	1.0%

### 7.3 Establishment of a Designated Area

Designated Areas (also called regulated areas by many OSHA substance specific standards) shall be set up in work areas where employee exposures could routinely exceed or be reasonably expected to exceed the action level (see Section 5.3). Unknowns and upset conditions are handled under Section 13.0 "Spills and Accidents".

All practical control strategies (see Section 5.0) shall be implemented prior to the establishment of a Designated Area.

Designated Areas shall be posted as "Restricted Access" in accordance with the requirements of ATS-310, Section 2.12, "Restricted Access Area Signage".

Before exiting the Designated Area, employees are required to remove all PPE in a pre-designated collection area.

---

<sup>1</sup> Chemical Abstract Services

Upon exiting the Designated Areas, employees shall be required to:

- Wash hands, forearms, face, and neck before starting other activities or prior to eating, drinking, smoking, applying cosmetics, etc., and
- After the last exit of the day, shower upon removal of contaminated clothing.

#### **7.4 Safe Removal of Contaminated Waste**

Prior to disposal, PPE, scrap, containers, debris, or other laboratory equipment contaminated with particularly hazardous substances shall be placed and stored in sealed bags or other closed containers designed to prevent dispersion of the particularly hazardous substance. These containers shall bear the particularly hazardous substances hazard warning labels (carcinogen or reproductive toxin), as applicable to the material, if the material is not managed as a Resource Conservation and Recovery Act (RCRA) hazardous or Washington State Dangerous Waste.

All particularly hazardous substances shall be handled as hazardous waste according to the requirements of the following laboratory waste procedures:

- ATS-LO-100-151, *Laboratory Waste Generation*
- ATS-LO-110-129, *Generation of Nonradioactive Waste and Recyclable Materials*

#### **7.5 Contamination Protection and Decontamination**

##### **7.5.1 Contamination Control**

- a. All surfaces shall be maintained as free, as practicable, of visible accumulations of chemical contamination (i.e., any unwanted material that can be removed from surfaces by means, such as casual contact, wiping, brushing, or washing).
- b. If contamination with the materials in Table 2 is reasonably anticipated to occur, procedures or test plans must include methods to control that contamination.

**Table 2. Substance-Specific Contamination Control Requirements**

Substance	CAS No.
Inorganic Arsenic	Varies by Compound
Lead	Varies by Compound
Chromium (VI) Compounds	Varies by Compound
Cadmium	Varies by Compound
1,2-Dibromo-3-chloropropane	96-12-8
Acrylonitrile	107-13-1
Formaldehyde	50-00-0
4,4'-Methylenedianiline	101-77-9
Methylene Chloride	75-09-2
Beryllium	Varies by Compound

- c. If leaks or spills are likely to occur, methods to detect exposure, including monitoring or visual inspections, shall be incorporated, as applicable, to the material being handled.
- d. After using any particularly hazardous substance, employees shall wash their hands in a non-Designated Area prior to eating, drinking, smoking, applying cosmetics, etc. (see Section 7.3 for definition of Designated Areas).
- e. When using occupational carcinogens, reproductive toxins or highly toxic chemicals, personnel shall protect laboratory vacuum systems from contamination. Refer to ATS-LO-110-130, *Vacuum Trap Setup and Operation*, for additional requirements associated with using laboratory trap systems.

#### 7.5.2 Decontamination

If methods to inactivate or treat the *chemical component are available* (e.g., water wash down of acrylonitrile), these methods shall be incorporated into procedures and test plans prior to cleaning equipment, performance of maintenance, or repair activities on contaminated equipment, or disposal of contaminated materials (including contaminated PPE).

### 7.5.3 Surface Cleaning

- a. If vacuuming is used to clean up material, high-efficiency particulate air filters or other methods that prevent dispersing of the material shall be used.
- b. Methods that should not be used to remove contamination if there is a potential that material can be dispersed include:
  - Compressed air
  - Blowing or shaking
  - Dry brushing, shoveling, or sweeping.

### 7.5.4 Equipment and Glassware Cleaning

- a. For equipment and glassware, personnel shall follow the specific decontamination instructions (such as equipment specific operating procedures).
- b. Refer to ATS-LO-190-141, *Decontaminate Equipment*, for additional requirements.

## 7.6 Additional Controls

- 7.6.1 Ensure that less hazardous substitutes are evaluated for each occupational carcinogen, reproductive toxin, or highly toxic chemical purchased. Include this information with the written justification required for the procurement of these chemicals.
- 7.6.2 Ensure chemical labeling clearly designates the chemical product as an occupational carcinogen, reproductive toxin, or highly toxic chemical. Products that can be demonstrated as having no exposure potential do not require labeling.
- 7.6.3 Ensure employees have documented training appropriate to the use of occupational carcinogen, reproductive toxin, or highly toxic chemical used. (See Section 11.0, *Employee Information and Training*).
- 7.6.4 Ensure employees who are exposed at predictable or anticipated levels to occupational carcinogens, reproductive toxins, or highly toxic chemicals have an Employee Job Task Analysis (EJTA) completed that addresses these chemicals. Refer to the following plans and procedures for additional information related to the use of EJTA:
  - (*ATL Employees*) ATL-MP-1028
  - (*ATL Employees*) ATL-MP-1037
  - (*ATL Employees*) ATL-312, Section 2.04, "Employment"
  - (*WRPS Employees*) TFC-ESHQ-S\_IH-C-17, *Employee Job Task Analysis*
- 7.6.5 Potential exposures for non-routine activities are identified through job hazard or job safety analysis or other similar processes.

## 8.0 CHEMICAL PROCUREMENT, STORAGE, AND DISTRIBUTION

Laboratory-use chemicals shall be procured, received, stored, and disposed of in accordance with:

- ATS-LO-150-063
- 29633-BOP-AIA-0001.

Before any manufacturer provided laboratory-use chemicals are released for use at the 222-S Laboratory Complex, an GHS-SDS/MSDS MUST be available in the Hanford Site GHS-SDS/MSDS database (<http://www7.rl.gov/msds/>).

### 8.1 Procurement of Chemicals

All laboratory-use chemicals shall be procured through the Standards Laboratory and be approved by the 222-S Laboratory Complex Chemical Management point of contact (POC). Additional procurement approvals are required by the above listed procedures for new laboratory chemicals, particularly hazardous substances, and certain high-risk chemicals.

8.1.1 New Chemicals. Laboratory-use chemicals that have not been ordered previously shall be approved by the industrial hygienist, environmental, and when applicable, radiological control and quality assurance, as described by LO-150-063.

8.1.2 Particularly Hazardous Substances. New laboratory-use chemicals that are occupational carcinogens, reproductive toxins, or highly toxic shall have written justification for their procurement and shall be approved by the industrial hygienist. Prior to purchasing particularly hazardous substances for the first time, the following items must be considered during justification:

- Does this material have an associated exposure limit (e.g., PEL, TLV, OEL)?
- Is there published acute toxicity data (e.g., Oral Rat LD50) for this material?
- Can a lower concentration product be used?
- Is the quantity of material being purchased the smallest amount needed to perform the work?
- Has management been notified that this substance is being used so that the appropriate EJTA's can be evaluated for its use?
- Has the process where this substance is going to be used been defined in laboratory procedures or test plans?
- Has the location where this work is going to be completed been identified?
- Have methods to control surface contamination, including leaks and spills, been evaluated?
- Is a plan available to ensure that the work area is decontaminated?

8.1.3 High-Risk Chemicals. Laboratory-use chemicals that may pose a higher hazard or risk when purchased in large quantities are specified in ATS-LO-150-063. These chemicals require approval by the industrial hygienist and laboratory engineering. ALL quantities of explosive chemicals, highly toxic chemicals,

Class 4 oxidizers, pyrophoric chemicals, or chemicals that reactive explosively with water require this additional level of approval.

## 8.2 Receipt of Chemicals

Chemicals delivered to the 222-S Laboratory Complex shall be received according to ATS-LO-150-063.

## 8.3 Storage of Chemicals

Chemicals should be stored in accordance with the recommendations of the manufacturer, such as those specified in the material's GHS-SDS/MSDS or container label, and according to their compatibility with other materials. This includes manufacturer's recommendations for temperature, moisture, and humidity control.

Incompatible chemicals must be appropriately segregated from each other. Refer to ATS-LO-150-063 for additional guidance.

At a minimum, the following groups of chemicals SHALL be stored separately:

- Oxidizers. Store away from flammable and combustible materials (e.g., ethanol, hexane, paper) and reducing agents (e.g., hydroxylamine hydrochloride, chloramineT, etc.). Common oxidizers in the laboratory include 30% hydrogen peroxide solutions, potassium persulfate, and fuming nitric acid (also a corrosive).
- Flammable and combustible materials. Store flammable solids (e.g., metal powders, alkyl metals, and charcoal) separately from flammable liquids (e.g., ethanol, hexane, toluene). Flammable and combustible liquids should be stored in an area segregated for flammable liquids. Refer to ATS-310, Section 9.8, "Control of Flammable Liquid Storage Cabinets," for additional requirements associated with the storage of flammable and combustible materials. Flammable and combustible liquids that require additional storage in refrigerators or freezers must be stored in those refrigerated units that conform to the requirements of NFPA 45.
- Corrosive materials. Store acids (e.g., nitric acid, hydrochloric acid, and sulfuric acid) separately from bases (e.g., sodium hydroxide and ammonium hydroxide). All corrosive materials should be stored away from flammable and combustible materials.

Some chemicals, such as glacial acetic acid (e.g., flammable and corrosive) or nitric acid (e.g., oxidizing and corrosive) require segregation from other chemicals with similar hazards due to their potential to be incompatible with other reagents with similar hazards.

Generally, laboratory chemicals should not be stacked because of the different container shapes and sizes. However, if the chemicals are stored in containers or outer packages that are capable of being stacked, then the chemical containers should be stacked in such a manner that they will not be unstable, fall, and cause a spill.

Chemical storage locations must be kept clean and orderly, and all containers tightly covered or closed when not in use. When practicable, newly received chemicals will be rotated with existing stock in a first in, first out rotation. See ATS-GD-1055 for definitions of various chemical hazards.

## 8.4 Distribution and Movement of Chemicals

Distribution of chemicals includes movement of chemicals within the 222-S Laboratory Complex and distribution of chemicals to users both within the 222-S Laboratory Complex and to groups outside the 222-S Laboratory Complex.

When moving chemicals in breakable containers within the 222-S Laboratory Complex, personnel shall place the container within an appropriate unbreakable secondary containment or on an appropriate cart that would allow the safe movement of the container in order to prevent an accidental breakage. This requirement does not apply to working with a chemical in an immediate work area, a hood, or bench top. If the movement of the chemical is to a new location, Standards Laboratory personnel shall be notified in accordance with the requirements of ATS-LO-150-063.

When distributing chemicals from the 222-S Laboratory, ensure chemicals are shipped in accordance with TFC-PLN-58, *Chemical Management Plan*.

When distributing to entities outside of the 222-S Laboratory Complex, a copy of the GHS-SDS/MSDS for each chemical comprised in the standard or reagent must be provided, and the chemical must be labeled in accordance with Section 9.2.

## 9.0 SIGNS AND LABELS

### 9.1 Signs

All laboratories shall prominently display signs with the following information.

- 9.1.1 Laboratory Complex emergency response boards shall display all emergency telephone numbers, including the phone numbers of the building operations lead (also known as the facility operations manager).
- 9.1.2 Entrances to laboratories shall be posted with signs to warn emergency personnel of unusual or severe hazards that are not related to the fire hazard.
- 9.1.3 Equipment location signs shall indicate safety showers, eyewash stations, first aid stations, fire protection equipment, and exits.
- 9.1.4 Refrigerators and freezers in laboratory areas shall be marked for its intended use (e.g., chemical storage, sample storage, flammable liquid storage, etc.).
- 9.1.5 Signs in Designated Areas shall be posted in accordance with the requirements of ATS-310, Section 2.12.
- 9.1.6 Refer to TFC-ESHQ-S-STD-18, *Safety Signs, Tags, Barriers, and Color Coding*, for additional guidance in the posting and design of signs.

### 9.2 Labels

- 9.2.1 Ensure each chemical container used or stored at 222-S Laboratory has a legible, prominently displayed label with the chemical identification and health and safety information as a minimum. Labels are not required on containers (e.g., flasks and beakers) that are intended only for the immediate use by the laboratory personnel

and are not left unattended; however, labeling even these containers is a good practice. Containers that are in the process of being analyzed are exempt from this requirement.

- 9.2.2 Standards Laboratory personnel shall follow the requirements of LO-120-001, *Labeling of Standards and Reagents by Standards Laboratory Personnel*, when labeling standards and reagents.
- 9.2.3 When labeling secondary containers used in the laboratory, personnel shall follow the requirements of ATS-LO-120-007.
- 9.2.4 When distributing to entities outside of the 222-S Laboratory Complex, each chemical container must be labeled in accordance with the requirements of 29 CFR 1910.1200 and must include NFPA health, flammability, and instability hazard ratings, specific hazard information, target organ information, and Hanford Site GHS-SDS/MSDS numbers. The Hanford Site uses the labeling system specified in NFPA 704, *Standard System for the Identification of Hazardous Materials for Emergency Response*. The Hanford Site GHS-SDS/MSDS administrator is the only Hanford approved source for the hazard information needed to comply with the NFPA 704. If the Hanford Site GHS-SDS/MSDS Administrator is not available, the Laboratory Chemical Management POC, Chemical Hygiene Officer, or Industrial Hygienist may be contacted for assistance.

## **10.0 WASTE GENERATION**

Before generating waste at the 222-S Laboratory Complex, the responsible chemist or technical authority will evaluate all impacts in accordance with:

- ATS-310, Section 6.3, “222-S Laboratory Complex PCB Waste Management”
- ATS-310, Section 6.4, “222-S Laboratory Complex Waste Management Program”
- ATS-310, Section 6.4.5
- ATS-LO-100-151, *Laboratory Waste Generation*
- ATS-LO-110-129.

## 11.0 EMPLOYEE INFORMATION AND TRAINING

Training requirements shall be met through facility chemical hygiene plan training, the Hanford General Employee Training (HGET), the facility orientation course, the facility emergency response course (Facility Emergency & Hazard Information Checklist [FEHIC]), and the procedure-specific training, such as employee qualification cards and on-the-job training (OJT). This training shall include information on methods and observations that may be used to detect the presence or release of a chemical, physical and health hazards of chemicals in the work place, and measures employees can take to protect themselves from these hazards including personal avoidance of routine exposures and training on the general classes of chemicals likely to be encountered. In addition, training on new procedures and test plans shall include information on hazards and methods to protect employees from exposure to those hazards.

Training shall be provided at the time of an employee's initial assignment to a work area where chemicals are present and prior to assignments involving new exposure situations. The HGET and FEHIC training require annual refresher training. Significant revisions to procedures are communicated through OJT, required reading assignments, or other means, as determined by the procedure technical authority.

This chemical hygiene plan, the documents referenced in this plan, chemical hygiene plan training, and OJT provide the necessary hazard communication information to meet OSHA requirements. Training records are documented in accordance with:

- (*ATL Employees*) ATL-312, Section 5.01, "Training Administration"
- (*WRPS Employees*) TFC-BSM-TQ-MGT-C-04, *Training Records Administration*.

## 12.0 MEDICAL CONSULTATION AND EXAMINATIONS

### 12.1 Conditions Warranting Additional Medical Consultation or Examinations

Employees who work with chemicals shall be provided an opportunity to receive appropriate medical consultation or examination, including follow-up examinations when determined necessary by the examining physician, under the following situations:

- 12.1.1 A spill, leak, exposure, or other event has occurred that may have resulted in suspect personnel exposure to a hazardous concentration of a chemical,
- 12.1.2 Exposure monitoring revealed the air concentration of a chemical is routinely above the action level (see Section 5.4),
- 12.1.3 Personnel develop signs or symptoms associated with exposure to a chemical, or
- 12.1.4 Personnel believe they have had a pre-1998 exposure to hazardous agents.

For additional requirements associated with responding and reporting exposures and accidents, refer to:

- (*ATL Employees*) ATL-312, Section 10.02, "Responding and Reporting Injuries and Illness Events"
- (*WRPS Employees*) TFC-ESQH-S\_CMLI-C-02, *Injury and Illness Events*.

For additional requirements associated with laboratory use of chemicals containing beryllium or beryllium compounds, refer to:

- (*ATL Employees*) ATL-MP-1043, *Beryllium Program*.
- (*WRPS Employees*) WRPS does not perform beryllium analyses subject to the requirements of 29 CFR 1910.1450.

## 12.2 Information Provided to Physician

The following information will be provided, if available, to the physician by WRPS and/or ATL:

- The identity of the chemical(s) to which the employee may have been exposed
- A description of the conditions under which the exposure occurred, including quantitative exposure data
- A description of the signs and symptoms that the employee may be experiencing.

## 12.3 Physician Response Requirements

When medical consultation or attention is required because of exposure or suspected exposure to toxic materials, the examining physician's written opinion shall include the following items as required by 29 CFR Part 1910.1450:

12.3.1 Recommendations for medical follow-up.

12.3.2 Results of the medical examination and any associated tests.

12.3.3 Any medical condition revealed during the examination that may place the employee at an increased health risk if exposed to a chemical found in the work place.

12.3.4 Statement that the physician has informed the employee of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

12.3.5 Additional information related to medical monitoring or surveillances can be found in:

- (*ATL Employees*) ATL-MP-1028
- (*WRPS Employees*) TFC-ESHQ-S\_IH-C-17.

12.3.6 The Hanford health care provider is responsible for providing the physician's written opinion.

## 13.0 SPILLS AND ACCIDENTS

### 13.1 Emergency Plan Requirements

Laboratory chemical-related spills and accidents are addressed in the FEHIC training, which is required annually. Elements that must be addressed include the following:

- Chemical contamination in the eye
- Skin contact with chemicals
- Ingestion of chemicals
- Inhalation
- Chemical spills within the laboratory
- Emergency training.

Emergency actions that are unique to a particular chemical shall be included in the chemical-specific procedures and test plans. In general, if skin comes in contact with a hazardous material, flush the affected area for 15 minutes while removing contaminated clothing, and call 911 or 373-0911 (from a cellular phone) for emergency assistance. For hydrofluoric acid exposures, flush for 5 minutes; then continually apply calcium gluconate gel until emergency help arrives.

### 13.2 Spills

If a chemical spill occurs, personnel must respond by:

#### 13.2.1 **SWIM** (Stop, Warn Others, Isolate Area, Minimize Exposure).

- a. **STOP** all associated work and equipment not required for safe operation.
- b. **WARN** others in adjacent areas.
- c. **ISOLATE** the area around the spill.
- d. **MINIMIZE** exposure:
- e. **IF** safe to do so, **STABILIZE** the spill (right the container, place spill pad on top of material, turn off source).

#### 13.2.2 **ENSURE** you are in a safe, upwind location.

#### 13.2.3 **NOTIFY** Building Emergency Director at 373-2435.

#### 13.2.4 **IF** needed, **NOTIFY** Patrol Operations Center at 373-0911 (from cellular phone) or 911.

#### 13.2.5 Cleanup and recovery personnel must use appropriate PPE when dealing with spills of chemicals.

### 13.3 Methods to Detect Spills or Releases

In the absence of real-time monitoring, laboratory employees should rely on their senses to detect spills or releases. Below are some general questions that employees can ask themselves to determine if there has been a spill or release of chemicals.

- Has the container tipped over?
- Are there any liquids or solids that have accumulated around the chemical container?
- Does the container have residue on it?
- Does the container or its labeling show signs of deterioration, such as cracking, yellowing or brittleness?
- Is the container or area around the container tacky, slippery, or sticky?
- Is there an unusual smell or odor near the container or in the storage area? Is there an unfamiliar or new noise, such as hissing or rattling, around the container?
- Have the radiation levels suddenly elevated?

Laboratory employees should also rely on the symptomatic responses of their body, such as:

- Do you feel dizzy, light-headed, or nauseated?
- Is there an irritating or burning sensation around the eyes, nose or mouth?
- Is there an unusual soapy, metallic, bitter, or pungent taste in the mouth?

### 14.0 CORRECTIVE ACTION

Incidents, accidents, or occurrences requiring corrective action or tracking will be documented in accordance with the following documents:

- (*ATL Employees*) ATL-312, Section 9.04, "ATL Corrective Action Management"
- (*WRPS Employees*) TFC-ESHQ-Q\_C-C-01, *Problem Evaluation Request*.

### 15.0 ANNUAL REVIEW

An annual review of the chemical hygiene plan shall be performed by members of the Chemical Hygiene committee.

#### 15.1 Annual Review Elements

- 15.1.1 Review of the chemical hygiene plan for accuracy with current conditions and compliance with Hanford Site and OSHA requirements.
- 15.1.2 Review of the training program for compliance with this chemical hygiene plan.
- 15.1.3 Corrections made to address findings and observations.
- 15.1.4 Documentation of the results of this evaluation.

### 16.0 FORMS

There are no forms used in performance of this plan.

## 17.0 RECORDS

The following records are generated during the performance of this plan:

- Chemical Hygiene Committee meeting minutes are maintained by ATL in accordance with ATL-MP-1005, *Records Management Program*
- Particularly Hazardous Substances Listings (maintained by ATL in accordance with ATL-MP-1005).

Records taken to monitor employee exposures shall be maintained in accordance with the requirements of TFC-ESHQ-IH-STD-03.

Records associated with employee's medical consultation and examinations (including tests or written opinions) shall be maintained by Hanford health care provider, as required by their contractual responsibilities.

## 18.0 SOURCES

### 18.1 Requirements

10 CFR Part 851, *Worker Safety and Health Program*

29 CFR Part 1910.1200, *Hazard Communication*

29 CFR Part 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*

29 CFR 1910, Subpart Z, *Toxic and Hazardous Substances*

### 18.2 References

29633-BOP-AIA-0001, *Administrative Interface Agreement between Washington River Protection Solutions, LLC. (WRPS) and Advanced Technologies and Laboratories International, Inc. (ATL) for 222-S Laboratory Analytical Services and Testing*

ACGIH, *TLVs and BEIs, Threshold Limit Values for Chemical Substances and Physical Agents, Biological Exposure Indices*, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio

ANSI Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*

ANSI Z89.1, *Industrial Head Protection*

ASTM F2413-05, *Standard Specification for Performance Requirements for Foot Protection*

ATL-312, *Advanced Technologies and Laboratories International, Inc. Administrative Procedures*,

- Section 2.04, "Employment"
- Section 5.01, "Training Administration"
- Section 9.04, "ATL Corrective Action Management"
- Section 10.02, "Responding and Reporting Injuries and Illness Events"
- Section 11.16, "Procedure Control and Use"

ATL-MP-1005, *Records Management Program*

*ATL-MP-1009, Integrated Environmental, Safety, and Health Management System Description for the 222-S Laboratory Analytical Services and Testing Contractor (ISMS)*

*ATL-MP-1020, Assessment Program*

*ATL-MP-1028, ATL Health and Safety Plan*

*ATL-MP-1032, ISMS Implementing Documents Matrix*

*ATL-MP-1035, Control of Working Hours and Working Alone*

*ATL-MP-1037, Worker Safety and Health Program*

*ATL-MP-1043, Beryllium Program*

*ATL-POL-011, ATL Health and Safety Policy*

*ATS-310, 222-S Laboratory Administration,*

- Section 1.9, "Laboratory Test Planning"
- Section 1.39, "Assessment Program"
- Section 2.12, "Restricted Access Area Signage"
- Section 6.3, "222-S Laboratory Complex PCB Waste Management"
- Section 6.4, "222-S Laboratory Complex Waste Management Program"
- Section 6.4.5, "Waste Stream Fact Sheet Development and Issuance (Pre-designation of Waste)"
- Section 9.2, "Safety Inspection Programs"
- Section 9.4, "222-S Laboratory Complex Eye Protection Requirements"
- Section 9.8, "Control of Flammable Liquid Storage Cabinets"
- Section 11.12, "Shift Turnover and Minimum Staffing Guidelines for 222-S Laboratory Complex"
- Section 11.16, "Technical Procedure Control Process"
- Section 11.16.1, "Laboratory Technical Procedure Writing and Formatting Guide"

*ATS-GD-1055, Common Definitions Associated with Chemical Hygiene and Chemical Management*

*ATS-LO-100-151, Laboratory Waste Generation*

*ATS-LO-110-129, Generation of Nonradioactive Waste and Recyclable Materials*

*ATS-LO-110-130, Vacuum Trap Setup and Operation*

*ATS-LO-120-007, Proper Labeling of Secondary Containers at 222-S Complex*

*ATS-LO-150-062, Management of Reactive and Time-Sensitive Chemicals in the Laboratory*

*ATS-LO-150-063, Chemical Management for the 222-S Laboratory Complex*

*ATS-LO-161-003, Fume Hood Use in the 222-S Laboratory*

*ATS-LO-190-141, Decontaminate Equipment*

*Bretherick's Handbook of Reactive Chemical Hazards, 1995 or current edition, Butterworth-Heinemann LTD*

IARC *International Agency for Research on Cancer (IARC) Monographs on the Evaluation of Carcinogenic Risks to Humans*, (<http://monographs.iarc.fr/>)

Lewis, Richard J., Sr., *Sax's Dangerous Properties of Industrial Materials*, 11th ed., John Wiley & Sons, 2004

LO-120-001, *Labeling of Standards and Reagents by Standards Laboratory Personnel*

National Fire Protection Association (NFPA) Codes and Standards

- NFPA 1, *Fire Code*
- NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*
- NFPA 704, *Standard System for the Identification of Hazards of Materials for Emergency Response*

National Toxicology Program, *Report on Carcinogens*, US Department of Health and Human Services, National Toxicology Program, Washington, District of Columbia

NIOSH, *Occupational Health Guidelines for Chemical Hazards*, National Institute for Occupational Safety and Health (<http://www.cdc.gov/niosh/docs/81-123/> )

RPP-MP-003, *Integrated Environment, Safety, and Health Management System Description for the Tank Operations Contractor*

RPP-33642, *Airborne Chemical Monitoring Review for 222-S Laboratory*

RPP-40939, *222-S Laboratory Fume Hood Performance Testing Program*

TFC-BSM-IRM-\_DC-C-02, *Records Management*

TFC-BSM-TQ-MGT-C-04, *Training Records Administration*

TFC-ESHQ-IH-STD-03, *Exposure Monitoring, Reporting, and Records Management*

TFC-ESHQ-IH-STD-11, *Carcinogen Control*

TFC-ESHQ-Q\_C-C-01, *Problem Evaluation Request*

TFC-ESHQ-S\_CMLI-C-02, *Injury and Illness Events*

TFC-ESHQ-S\_IH-C-02, *Hazard Communication*

TFC-ESHQ-S\_IH-C-05, *Respiratory Protection*

TFC-ESHQ-S\_IH-C-17, *Employee Job Task Analysis*

TFC-ESHQ-S\_IS-C-02, *Personal Protective Equipment*

TFC-ESHQ-S\_SAF-C-02, *Job Hazard Analysis*

TFC-ESHQ-S\_SAF-C-03, *Control of Working Hours and Working Alone*

TFC-ESHQ-S-STD-18, *Safety Signs, Tags, Barriers, and Color Coding*

TFC-PLN-01, *Integrated Environment, Safety, and Health Management System Plan*

TFC-PLN-10, *Assessment Program Plan*

TFC-PLN-34, *Industrial Hygiene Exposure Assessment Strategy*

TFC-PLN-47, *Worker Safety and Health Program*

TFC-PLN-58, *Chemical Management Plan*

TFC-POL-14, *WRPS Safety and Occupational Health*

*The MERCK Index, An Encyclopedia of Chemicals, Drugs and Biologicals*, Merck and Co., Inc.,  
Ranway, N.J.

### Appendix A. Hand Protection

This attachment provides guidance to help identify appropriate materials for hand protection. After consideration of the chemical (procedure safety section), radiological (RWP requirements), and physical hazards (Job Hazard Analysis [A-6004-101] / Laboratory Worksite Hazard Analysis [A-6004-775]), the employee is required to wear protective clothing, or a combination of protective clothing, which adequately addresses all hazards involved.

For some of the glove materials, different glove thicknesses are shown to demonstrate chemical resistivity changes as the glove thickness changes. The disposable gloves (i.e., surgeons' gloves) that are commonly used in the laboratory have a thickness of about 4 to 8 mil. Caution should be used when evaluating glove chemical resistivity data because much of the data published is for the thicker gloves and not for the disposable gloves. Particularly with organic materials, permeation of the glove may occur without noticeable deterioration.

The following chart is intended only as a guide to enable informed decisions on which glove is more effective for a given chemical. Data is compiled from information published by Showa Best Glove, Inc. ([www.showabestglove.com](http://www.showabestglove.com)), North by Honeywell ([www.northsafety.com](http://www.northsafety.com)), Ansell Healthcare ([www.ansellpro.com](http://www.ansellpro.com)), and Kimberly-Clark Professional ([www.kcprofessional.com](http://www.kcprofessional.com)) as of October 24, 2012. When data has differed, the lowest value reported is listed below.

If the chemical of concern is not listed or there is no recommended glove type for a listed chemical, contact the CHO and the Safety Representative for assistance in determining appropriate hand protection.

In laboratory-use, disposable gloves are intended to provide chemical protection against incidental splashes and must be changed immediately after unintended contact with any chemical.

**Table 3. Hand Protection, Chemical Resistance Information**

Glove Types Chemical Protective Material Type	Disposable (Surgeons') (6-8 mil)			Reusable, (20 mil)		Silver Shield
	Nitrile	Latex	Vinyl	Neoprene	Latex	Laminate
1,3-butadiene	E	N/A	N/A	N/A	N/A	E
Acetic acid	P	G	F	E	G	N/A
Acetone	P	G	P	F	G	E
Acetonitrile	P	F	P	P	F	N/A
Ammonium hydroxide, conc. (28-30% Ammonia)	P	F	E	E	F	N/A
Benzene	P	P	P	P	P	E
Butanol	F	E	F	E	E	N/A
Chloroform	P	P	P	P	P	E
Diethyl ether	P	P	P	F	P	E
Dimethyl mercury	P	P	P	P	P	E
1,4-Dioxane	P	F	P	P	F	N/A
Hexane	F	P	P	F	P	E
Hydrochloric acid, 37%	F	E	P	G	E	E
Hydrofluoric acid, 30%	E	E	P	E	E	E
Hydrogen peroxide, 30%	G	E	P	G	E	N/A
Isooctane	G	P	P	G	P	N/A
Isopropanol	F	E	G	G	E	N/A
Methylene chloride	P	P	P	P	P	E
Methyl ethyl ketone (2-butanone)	P	F	P	P	F	N/A
Nitric acid 10%	G	E	P	E	E	N/A
Nitric acid, 70%	P	P	P	G	P	N/A
Phenol, 90%	P	F	F	E	F	E
Potassium hydroxide, 50%	E	E	P	E	E	N/A
Sodium hydroxide, 50%	E	E	P	G	E	E
Sulfuric acid, 95-98%	P	P	P	F	P	E
Tetrahydrofuran	P	P	P	P	P	E
Toluene	P	P	P	P	P	E

E, G: Excellent, Good - recommended

F: Fair - adequate, but not ideal

P: Poor - not recommended

N/A: data not available

## Appendix B. Additional Information

The following web links provide additional information on subjects such as carcinogens, reproductive toxins, laboratory safety, etc. The hyperlinks listed below were current at the time this plan was released; however, they may or may not be current when accessed. The information posted on these web pages has not been verified and should be used for additional information only. Contact the Chemical Hygiene Officer or the Industrial Hygienist for additional assistance with a chemical that may be indicated as having a high health or physical hazard.

A.	Aggregated Computational Toxicology Resource (ACToR) – EPA’s online warehouse of all publicly available chemical toxicity data	<a href="http://actor.epa.gov/actor/faces/ACToRHome.jsp">http://actor.epa.gov/actor/faces/ACToRHome.jsp</a>
B.	Agency for Toxic Substances and Disease Registry (ATSDR)	<a href="http://www.atsdr.cdc.gov">http://www.atsdr.cdc.gov</a>
C.	Centers for Disease Control and Prevention	<a href="http://www.cdc.gov/">http://www.cdc.gov/</a>
D.	DOE Office of Environment, Safety and Health	<a href="http://www.hss.energy.gov/index.cfm">http://www.hss.energy.gov/index.cfm</a>
E.	DOE Chemical Safety Program	<a href="http://www.hss.energy.gov/healthsafety/wshp/chem_safety/">http://www.hss.energy.gov/healthsafety/wshp/chem_safety/</a>
F.	Environmental Protection Agency	<a href="http://www.epa.gov/">http://www.epa.gov/</a>
G.	International Agency for Research on Cancer (IARC)	<a href="http://www.iarc.fr/">http://www.iarc.fr/</a>
H.	Medical Dictionary Online	<a href="http://www.online-medical-dictionary.org/">http://www.online-medical-dictionary.org/</a>
I.	Safety Emporium MSDS Hyper Glossary	<a href="http://www.ilpi.com/msds/ref/index.html">http://www.ilpi.com/msds/ref/index.html</a>
J.	National Institute for Occupational Safety and Health	<a href="http://www.cdc.gov/niosh/">http://www.cdc.gov/niosh/</a>
K.	National Toxicology Program (NTP)	<a href="http://ntp-server.niehs.nih.gov/">http://ntp-server.niehs.nih.gov/</a>
L.	New Jersey Right to Know Hazardous Substance Fact Sheets	<a href="http://web.doh.state.nj.us/rtkhsfs/indexfs.aspx">http://web.doh.state.nj.us/rtkhsfs/indexfs.aspx</a>
M.	Occupational Safety & Health Administration	<a href="http://www.osha.gov/">http://www.osha.gov/</a>
N.	OSHA Hazard Communication – Globally Harmonized System of Classification and Labeling of Chemicals	<a href="http://www.osha.gov/dsg/hazcom/index.html">http://www.osha.gov/dsg/hazcom/index.html</a>
O.	OSHA Occupational Chemical Database	<a href="https://www.osha.gov/chemicaldata/">https://www.osha.gov/chemicaldata/</a>
P.	State of California’s Office of Environmental Health Hazard Assessment, Proposition 65, <i>Safe Drinking Water and Toxic Enforcement Act of 1986</i>	<a href="http://www.oehha.ca.gov/prop65.html">http://www.oehha.ca.gov/prop65.html</a>