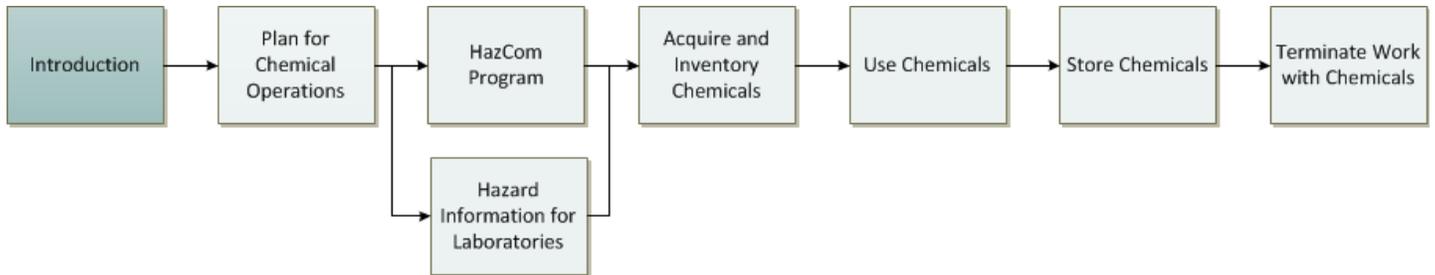

SUBJECT AREA CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))

Periodic Review Due: **Oct 29, 2019**



Introduction

This subject area provides requirements and guidance for users of chemicals at Brookhaven National Laboratory (BNL). Compliance with these requirements ensures that BNL workers and guests are provided safe workplaces and healthy environments. This subject area and its exhibits and references form the *Hazard Communication Program (HazCom)* for industrial and construction operations and the *Chemical Hygiene Plan* for laboratory-scale experimentation. The SME for the Chemical Safety Subject Area is designated to be responsible for implementation of the Chemical Hygiene Plan and serves as the Chemical Hygiene Officer.

This subject area also plays a role in the BNL work planning and control requirements for work involving chemicals. The subject area addresses requirements for training, use, and storing chemicals in a manner that meets Laboratory expectations.

Chemical use by contractors and sub-contractors on construction sites is not covered in this subject area. The Hazard Communication program for these operations is covered in the Health and Safety Plans, Safe Work Plans, Job Hazard Analysis, and other documentation as required by the [Construction Safety](#) Subject Area.

Standards of Performance

- All staff and guests shall comply with applicable Laboratory policies, standards, and procedures, unless a formal variance is obtained.
- Managers shall analyze work for hazards, authorize work to proceed, and ensure that work is performed within established controls.
- All staff and users shall identify, evaluate, and control hazards in order to ensure that work is conducted safely and in a manner that protects the environment and the public.
- All staff and users shall ensure that they are trained and qualified to carry out their assigned responsibilities, and shall inform their supervisor if they are assigned to perform work for which they are not properly trained or qualified.

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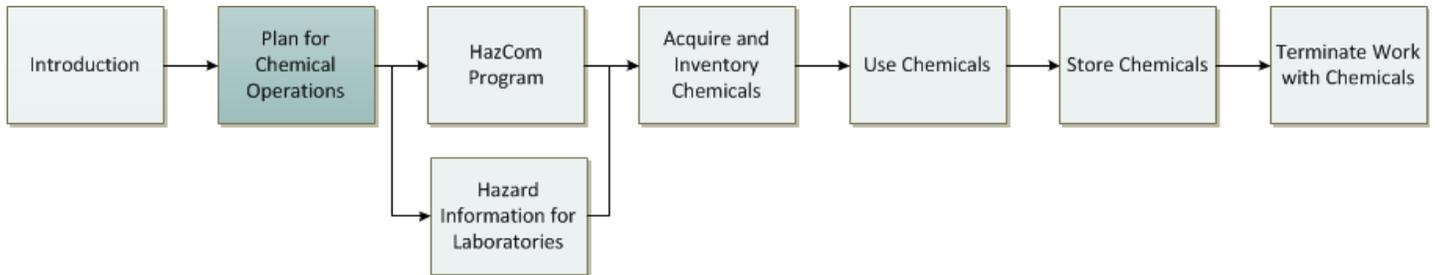
Questions/Comments

SUBJECT AREA PROCEDURE CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))
Periodic Review Due: **Oct 29, 2019**



For staff who plan the use of chemicals in industrial settings and laboratories.

Plan for Chemical Operations

1. ES&H Coordinators, in conjunction with Line Management designees, determine if work/areas fall into one of the following categories:

The following substances are exempted by this subject area:

1. Chemicals are used in industrial operations or construction (Hazard Communication);
2. Chemicals are used in laboratories (Laboratory Standard);
3. Only exempted substances are present. (This subject area is not applicable).
4. No chemicals are present. (This subject area is not applicable).
 - Tobacco products, foods, and cosmetics;
 - Consumer products used in a manner consistent with typical consumer use (e.g., typing correction fluid, glass cleaner, copier toner, and scouring powder);
 - Prescription drugs when used in a manner prescribed by a physician;
 - Over-the-counter medications;
 - Controlled substances used in human and animal research;
 - Etiologic Agents and biohazards in research applicable substances (except toxins of biological origin); and
 - Radiological and nuclear materials.

2. When work will involve chemicals, plan the work using the [Work Planning and Control for Experiments and Operations](#) Subject Area processes.

Plan work to comply with the following sections of requirements:

- Acquire and Inventory Chemicals;
- Use Chemicals;
- Store Chemicals; and
- Terminate Work with Chemicals.

For laboratories:

- Plan work using the Experimental Safety Reviews (ESR) and other work planning documents, such as Standard Operating Procedures, Operator Aids, Work Permits, and published instructions or methodology (e.g., vendor operating or maintenance manuals) can serve this role;

For HazCom operations: Use the Work Planning and Control process when planning chemical operations. Update the documentation when new chemical hazards are introduced. For non-routine HazCom operations (for example, the cleaning of reactor vessels), inform employees of the hazards using any of the following work planning tools:

- Work Permit

- Standard Operating Procedure, or
 - Other work planning document (e.g., published operating or maintenance manuals).
3. During work planning, a Safety & Health Representative (or line organization approved ESH professional with Industrial Hygiene background) performs an assessment of potential occupational exposure and determines the need for exposure monitoring to determine compliance with occupational exposure limits and if the planned control measures will maintain employee exposure to acceptable levels.
 4. Plan work with hazardous chemicals to minimize worker exposure using the control techniques in the hierarchy of controls. Use engineering controls (e.g., a functioning laboratory hood, glove box, or other engineering controlled setting) whenever feasible. When engineering controls are not feasible, use administrative controls and Personal Protective Equipment (PPE) to minimize risk to any possible exposure. If a hazardous chemical will be used outside of an engineering control (hood or glove box) in a manner capable of generating airborne levels of chemical OSHA above action level or the PEL/TLV or an OSHA Particularly Hazardous Substances is used, the Safety & Health Representative (or line organization approved ESH professional with Industrial Hygiene background) reviewing the ESR will evaluate the need for exposure monitoring.
 5. If work with an OSHA Regulated Chemical (29 CFR 1910 Subpart Z) will be used with the potential to generate employee exposures above the OSHA Permissible Exposure Limits, a regulated area will need to be created to control access to the area. The Safety & Health Representative (or line organization approved ESH professional with Industrial Hygiene background) will evaluate the need for exposure monitoring.
 6. Provide emergency eyewashes and safety showers in areas with a splash hazard from corrosives, formaldehyde, eye irritants, or chemicals that are toxic via skin and/or eye.
 - Design new eyewashes and safety showers to comply with ANSI Z358.1 "American National Standard for Emergency Eyewash and Shower Equipment".
 - Install shower/eyewashes in the immediate work area at a location that can be reached by a blinded worker in an unimpeded path within 10 seconds (approximately 50 feet).
 - Where the eyes or body of a person may be exposed to injurious corrosive materials, provide suitable facilities for quick drenching or flushing of the eyes and body within the work area for immediate emergency use. Ensure there are no obstructions to the pathway to the eyewash and shower. Consult the [Guidance on Ensuring an Unobstructed Pathway to Eyewashes and Showers When Working With Corrosives](#) on the [ESH Guide: Chemicals](#) website.
 - For HazCom operations, where the temporary work with formaldehyde or a corrosive chemical is done in an area without an eyewash and shower, provide alternative means of eye and skin protection (such as portable stations).
 - If a shower or eyewash is not operable, notify the ESH Coordinator/Research Space Manager and occupants to suspend work with corrosives, eye irritants, or chemicals that are toxic via skin and/or eye contact until the equipment is made operable.
 - If shutoff valves are installed in the supply line to eyewashes or showers, ensure a mechanism is provided to control the inadvertent closing of water line valves to eyewashes and showers. Examples of acceptable mechanisms are
 - Warning tags or signs to advise that the valve(s) must remain open except for maintenance
 - Removal of handles
 - Covers over handles and valves

Note: As an interim measure until a control method is in place, maintenance staff may be trained to verify the impact of closing water valves on eyewashes and showers and to confirm the shower/eyewash is operable after work is done in the area of these valves.

 - Have emergency eyewashes and safety showers inspected & tested annually by F&O to ensure they continue to meet ANSI Z358.1 "American National Standard for Emergency Eyewash and Shower Equipment". Notify your ES&H Coordinator if an inspection tag is found that shows a past due date.
 - Periodically activate the eyewash stations (if drainage is plumbed). This will help ensure proper operation and keep the water fresh. All users are permitted and encouraged to activate their equipment regularly. When chemical use is very intermittent, an acceptable practice can be activating the eye wash prior to resuming work with chemicals.

The recommended "Test" and "Activation" frequency are:				
Hazard	Test*		Activation**	
	Eyewash	Shower	Eyewash	Shower
Battery Charging with unsealed acidic electrolytes	Annual	Annual	Quarterly	Quarterly
Chemicals that are corrosive to eye or skin	Annual	Annual	Quarterly	Quarterly
Formaldehyde (>1%)	Annual	Annual	Weekly	Annual

*Testing means a formal measurement of flow, temperature, and spray pattern. This is a task performed by F&O.

**Activating means starting the water for a brief period (a few seconds to less than a minute). It should only be done for units with plumbed drains or where a catch bucket/pan can be used.

7. Determine environmental impact and make provisions for waste minimization, contaminated PPE waste disposal, pollution prevention, spill response, and recycling of chemicals. Consider waste type and disposal cost in the planning of chemical use. Follow these subject areas and information resources:
 - Environmental Management System Management System Description;
 - [Sink-Releasable Chemical List](#) in the [Liquid Effluents](#) Subject Area;
 - [Hazardous Waste Management](#) Subject Area;
 - [Spill Response](#) Subject Area;
 - [Emergency Preparedness](#) Subject Area.
 - Contact the [Environmental Compliance Representative \(ECR\)](#) or [Waste Management Representative](#) for assistance.

8. Plan operations to minimize working alone with hazardous chemicals.

Guidance

Work planning should minimize worker exposure to hazards in a hierarchy of controls that seeks the most effective controls considered first. The preferred hierarchy of controls are:

- Eliminate the hazard chemical source by change in the design or elimination of exposure potential.
- Substitute a less hazardous chemical. Exposure potential is still there but the hazard is lessened.
- Reduce the chemical's hazard, such as reducing a source's concentration, pressure, or temperature.
- Engineering controls by a mechanical device, such as a ventilation system (lab hood or local exhaust).
- Warning Systems: audible and visual signals;
- Administrative controls: procedures, rules, training, dry-runs, and rehearsals of tasks with non-hazardous substitutes.
- Personal protective equipment worn by the worker, such as glasses/face shields; respirators; head/body/hand protection (lab coats, hard hats, coveralls, gloves); etc. Least desired method because it can be worn incorrectly, forgotten to put on). More details are in the [Personal Protective Equipment and Respirators](#) Subject Area.

When working alone in a laboratory setting, the [Unattended Chemical Experiment Form and Instructions](#) may be used.

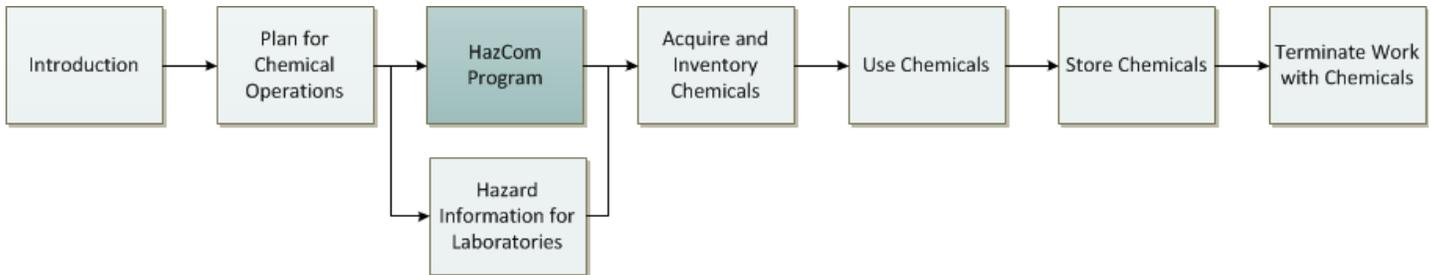
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SUBJECT AREA PROCEDURE CONTENT

★ - **Chemical Safety** Subject Area
Effective Date: **Nov 24, 2015** ([Rev 22.1](#))
Periodic Review Due: **Oct 29, 2019**



For staff who supervise chemical users or who are assigned to use chemicals in an industrial setting and construction/maintenance projects.

BNL Hazard Communication Program for Industrial Areas

1. Provide workers with chemical hazard training at the time of their initial assignment and whenever a new chemical hazard is introduced by taking the [Hazard Communication \(HP-IND-200\)](#) web course (or equivalent). HP-IND-200 provides information on hazardous chemicals by covering categories of hazards (e.g., flammability, carcinogenicity). Alternative training classes that address specific chemicals can be used if that format is judged to be more effective.
Training needs to be approved by the Chemical Hygiene Officer and must include the following criteria: requirements of the OSHA Hazard Communication Standard; availability of the written hazard communication program; accessing the required list(s) of hazardous chemicals and Safety Data Sheets (SDS); and methods to detect the presence or release of a hazardous

chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.).

For more information on chemical safety training, contact the Department/Division [Training Coordinator](#) or see the [Training and Qualifications](#) Web site.

2. Provide training to those working with the following chemicals or operations via these classes:

- [Beryllium Use at BNL \(TQ-BERYLLIUM1\)](#)
- [Chemical Protective Clothing User Training \(HP-OSH-157\)](#)
- [Cadmium Training for HazCom Operations \(TQ-CADMIUM\)](#)
- [Compressed Gas Safety \(TQ-COMPGAS1\)](#)
- [Corrosive Etch Solutions \(TQ-CORETCH\)](#)
- [Cryogen Safety \(HP-OSH-025\)](#)
- [Hazardous Waste Generator \(HP-RCRIGEN3\)](#)
- [Methylene Chloride Training for HazCom Operations \(TQ-MCAT\)](#)
- [Nanotechnology for Support Personnel \(TQ-NC-HS1\)](#)
- [Spill Prevention, Control, and Countermeasure \(TQ-SPCC\)](#)
- [Transportation of Hazardous Material \(TQ-HAZMAT-A\)](#)

The following optional web classes are available to help workers improve their understanding of chemical safety:

- [Area-Based PPE & Hazard Information Placarding \(TQ-AREA-PPE\)](#)
- [Fire Extinguisher Safety \(TQ-FIRE-EXT\)](#)

3. Provide workers access to information on reproductive hazards via the BNL training courses [Hazard Communication \(HP-IND-200\)](#) and [Lead in the Workplace \(TQ-LEAD1\)](#).

Pregnant laboratory workers may discuss the work they perform and the hazardous materials they handle with their personal physicians to determine if any work restrictions are necessary. In some cases, certain chemicals may need to be substituted for other reagents, or certain activities curtailed, for the duration of the pregnancy. Restrictions placed by the attending physician may be discussed with BNL's Occupational Medicine Clinic (OMC) Manager. Basic chemical hygiene practices (such as wearing protective gloves and washing hands frequently) are always important when working with hazardous materials. These practices are even more important for women who work in laboratories while they are pregnant or attempting to become pregnant.

4. Inform workers of the location of the emergency eyewash, safety shower, fire alarm pull-box, telephone, fire extinguisher, and spill control materials (if applicable) before beginning work.

5. Provide workers with the OSHA and BNL chemical safety information available to them via these links:

- OSHA [Hazard Communication 29 CFR 1910.1200](#) Standard;
- OSHA guidance web pages & brochures: [Hazard Communication Standard](#), [Hazard Communication Safety Topic](#);
- Information on the hazards of non-routine tasks in the work planning document created as part of the [Work Planning and Control for Experiments and Operations](#) Subject Area;
- The hazards associated with chemicals contained in unlabeled pipes in their work areas as addressed in the [Piping Systems](#) section in the [Signs, Placards, and Labels for Environmental, Safety and Health \(ESH\) Hazards](#) Subject Area.

6. Provide workers access to the chemical inventory and Safety Data Sheets (formerly known as Material Safety Data Sheets) via the [Chemical Management System \(CMS\)](#).

Ensure that the Safety Data Sheets (SDS) are available in the workplace for each hazardous chemical used during each work shift to employees when they are in their work area. Having workers access the on-line Chemical Management System's SDS database is the recommended method of providing the SDS. BNL maintains all MSDSs received in the MSDS Database. This database serves as the official site for SDS/MSDS at BNL and ensures that the most current version is available to BNL workers. Backup copies of MSDSs are kept in a central location (CMS/MSDS Team Office, Building 120) should the on-line system fail. Contact the CMS/MSDS Team for an SDS when the online database is not available by calling phone x6387 or x2028 or email the CMS Team.

If printed, workplace copies of the SDSs are maintained by a line organization, they must be maintained in compliance with

the [Document Control](#) Subject Area.

If an MSDS is not available for a chemical in the workplace, contact the CMS Team by calling phone extension x6387 or x2028 or email the CMS Team to have the appropriate SDS put into the system as soon as possible. If a MSDS is received for a product at BNL that is not in the MSDS database, email or send a copy to the CMS Team in Building 120 so that the database can be updated.

7. Label containers to inform workers of the content and hazards:

- Maintain Manufacturer's labels on chemical containers. Do not deface or remove manufacturer's label unless it is replaced with a label of equal content.
- When chemicals are transferred from the original container into a new container to be used in the same area (i.e., workplace labeling), prepare a label on chemical container as follows:
 - Record the chemical name and primary hazard(s) on the new workplace label  by including either
 - Product identifier; Signal word; Hazard statement(s); Pictogram(s); Precautionary statement(s); and, Name, address, and telephone number of the responsible party, or
 - Product identifier and words, pictures, symbols, or combination thereof, which provide at least general information regarding the hazards of the chemicals so that with the other information immediately available the employee is provided with the specific information regarding the physical and health hazards. The NFPA diamond along with access to the SDS is an alternative to text on the label  that specifies the hazard (optional). Labels are available from the BNL Storeroom as 1.5" x 3.9" paper (S-33832), and 3" x 4" Vinyl (S-33839).
 - If the chemical is a carcinogen, record the chemical name, primary hazard(s), and "Carcinogen" on the new label.
 - On equipment whose content changes with time or containers that are hard to label, an identification system on the container that directs users to a source that provides the content and hazard can be used. Signs, placards, process sheets, batch tickets, operating procedures, or other such written materials can be used in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the hazard information.
 - Workplace labels must be legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift.
 - A label with the content of the OSHA's Manufacturer's Chemical Container Label  can be used for Workplace Labeling (optional).
Note: Portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer are not required to be labeled (example, a bucket used to carry a solution from a source to a mixing tank).

The following types of containers are **NOT** subject to labeling under OSHA requirements:

- Pesticides subject to labeling by the EPA;
- Chemical substances or mixtures subject to labeling under the TSCA by the EPA;
- Food, food additives, color additives, drugs, cosmetics, and medical/veterinary products, including ingredients in such products (e.g., flavors and fragrances), are subject to the labeling requirements by FDA or SDA;
- Distilled spirits (beverage alcohols), wine, or malt beverages intended for nonindustrial use are subject to labeling regulations by ATF;
- Consumer products or hazardous substances subject to a consumer product safety standards or labeling requirement of those acts or regulations issued by the CPSC;
- Agricultural or vegetable seed treated with pesticides labeled in accordance with the USDA;
- Nuisance particulates where the chemical manufacturer or importer can establish that they do not pose any physical or health hazard covered under this section;
- Ionizing and non-ionizing radiation sources; and
- Biological hazards.

8. Post areas with chemical hazards:

- Place a Hazard Information/Emergency placard at entrances to chemical use/storage areas as per the [Signs, Placards, and Labels for Environmental, Safety and Health \(ESH\) Hazards](#) Subject Area.
- Place "Danger" signs with the chemical name and "Regulated Area - Authorized Personnel Only" in HazCom areas where

OSHA Regulated Chemicals (see [Definitions](#)) are above the action level (or PEL when not action level is prescribed by OSHA).

9. When planning to ship chemicals from BNL to an off-site location

- Place a label that meets the OSHA Requirements for the contents of a Manufacturer's Chemical Container Label  on the container.

- Include a Safety Data Sheet (SDS) that meets the OSHA Requirements for the contents of a Safety Data Sheet with the shipment. If a chemical has been created at BNL, for which a SDS does not already exist, a SDS needs to be prepared. Contact the Chemical Hygiene Officer (Chemical Safety SME) for assistance in generating the required document. The chemical owner needs to provide information on the composition and physical properties of the substance so that a SDS can be prepared. The preparation of a Safety Data Sheet requires an extensive literature search for toxicological and physical properties and hazards done by one of several companies that research and prepare the SDS in a cost effective manner. A lead time of several weeks is needed. A fee of \$100 to \$200 is charged by the company preparing the SDS.

10. When BNL's use of chemicals has the potential of hazardous exposure to the workers of other employers (i.e., multi-employer workplaces), provide a means to communicate the hazards, precautionary measures to be taken, labeling system, and method to access to the SDS for hazardous chemicals to the other employer(s) employees.

- BNL's main mechanisms to provide this information are the on-line [Chemical Management System \(CMS\)](#) and the [Hazard Validation Tool](#).
- Awareness of these mechanisms is provided during Contractor Vendor Orientation class.

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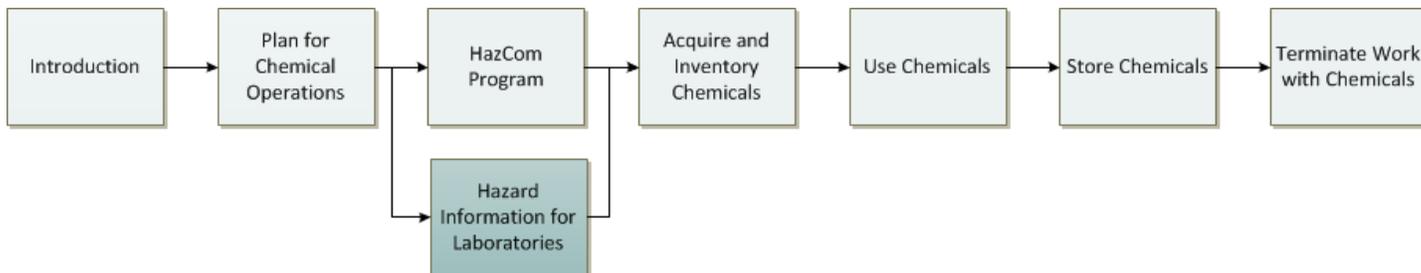
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SUBJECT AREA PROCEDURE CONTENT



Chemical Safety Subject Area
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Periodic Review Due: **Oct 29, 2019**



For staff who supervise chemical users or who use chemicals in laboratory setting.

Hazard Information for Laboratories

1. Train workers in laboratory-scale operations of the hazards associated with materials they use, use and limitations of control measures, warning signs of exposure (e.g., odors, irritation, etc.), and the emergency procedures for off-normal events. The BNL course [Laboratory Standard \(HP-IND-220\)](#) or equivalent provides this information. For more information on chemical safety training, contact the Department/Division Training Coordinator or see the BNL Training and Qualifications Web site. Advise personnel working with OSHA Particularly Hazardous Substances of the special hazard of the chemicals in use prior to assignments involving new exposure situations, as appropriate. The Laboratory Standard (HP-IND-220) course covers the special hazards. [Hazard Communication \(HP-IND-200\)](#) and the [Laboratory Standard \(HP-IND-220\)](#) course cover the special hazards. When airborne levels exceed the Action Level, ensure workers complete

If there is a need for chemical hazard training not covered in the [Laboratory Standard \(HP-IND-220\)](#) course, the [Safety & Health Representatives](#) are available to assist in providing job specific training on chemical hazards.

- Cadmium Training for HazCom Operations (TQ-CADMIUM)
- Methylene Chloride Training for HazCom Operations (TQ-MCAT)

2. Provide training for those working with the following chemicals or operations:

- Beryllium Use at BNL (TQ-BERYLLIUM1)
 - Chemical Protective Clothing User Training (HP-OSH-157) [if a chemical protective suit or chemical impervious glove for immersion into chemicals is required]
 - Compressed Gas Safety (TQ-COMPGAS1)
 - Compressed Gas Safety (TQ-COMPGAS1)
 - Nanotechnology for Nano Workers (TQ-NC-HS2)
 - Nanotechnology for Support Personnel (TQ-NC-HS1)
 - Spill Prevention, Control, and Countermeasure (TQ-SPCC)
 - Transportation of Hazardous Material (TQ-HAZMAT-A)
 - Hazardous Waste Generator (HP-RCRIGEN3)
- The following optional classes are available to help workers improve their understanding of chemical safety and certain operations involving chemicals:

- Area-Based PPE & Hazard Information Placarding (TQ-AREA-PPE)
- Ergonomics in the Laboratory Setting (TQ-ERGO-LAB)
- Fire Extinguisher Safety (TQ-FIRE-EXT)
- Glovebox Worker Awareness (TQ-ERGO-GB)

3. Inform workers of reproductive hazards. The BNL training courses *Chemical Hygiene Laboratory Standard (HP-IND-220)*, *Hazard Communications (HP-IND-200)*, and *Lead in the Workplace (TQ-LEAD1)* safety courses address this topic (see the [Training and Qualifications](#) Web site).

When an occupational workplace evaluation has determined there is unacceptable risk from reproductive hazards posed to impacted worker(s), reassess job assignments and controls. Reproductive hazard chemicals can adversely affect the reproductive health of both male and female workers. Workers who are pregnant or seeking to bear children (both male and female workers) are encouraged to seek professional evaluation of their work areas for reproductive hazards.

- Staff and supervisors can request an occupational workplace evaluation by contacting their [ESH Coordinator](#) or [Safety & Health Representative](#).
- Contact the Occupational Medicine Clinic (OMC) to discuss medical concerns that pertain to reproductive hazards.
- Pregnant laboratory workers may discuss the work they perform and the hazardous materials they handle with their personal physicians to determine if any work restrictions are necessary. In some cases, certain chemicals may need to be substituted for other reagents, or certain activities curtailed, for the duration of the pregnancy. Restrictions placed by the attending physician may be discussed with BNL's Occupational Medicine Clinic (OMC) Manager.

4. Inform workers of the location of the emergency eyewash, safety shower, fire alarm pull-box, telephone, fire extinguisher, and spill control materials (if applicable) before beginning work.

5. Provide workers with the OSHA chemical safety information available to them via these links:

- OSHA [Laboratory Safety 29 CFR 1910.1450](#) Standard;
- OSHA guidance web pages and brochures [Laboratory Standard Publication 3404](#) and [Laboratories Safety Topic](#).

6. Provide workers access to the chemical inventory and [Safety Data Sheets](#) (formerly known as Material Safety Data Sheets) via the [Chemical Management System \(CMS\)](#).

7. Label containers to inform workers of the content and hazards.

- Maintain Manufacturer's labels  on chemical containers. Do not deface or remove manufacturer's label unless it is replaced with a label of equal content.
- When chemicals are transferred from the original container into a new container to be used in the same area (i.e.,

workplace labeling), prepare a label on chemical container as follows:

- Record the chemical name on the new label.
- If the chemical is a carcinogen, record the chemical name and "Carcinogen" on the new label.
- For small or hard to label containers, a logbook reference number or other alternative chemical content identification system can be used.
- Workplace labels must be legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift.
- The NFPA diamond  can be used to indicate the hazard (optional). Labels are available from the BNL Storeroom as 1.5 " x 3.9" paper (S-33832) and 3" x 4" Vinyl (S-33839).

8. Post the chemical hazards of the laboratory:

- Place a Hazard Information/Emergency placard at entrances to chemical use/storage areas following the [Signs, Placards, and Labels for Environmental, Safety and Health \(ESH\) Hazards](#) Subject Area.
- Place "Danger" signs with the "Carcinogen", "Reproductive hazard", or "Highly acute toxin" (as applicable) and "Designated Area- Authorized Personnel Only" in laboratory areas where OSHA Particularly Hazardous Substances are used or stored. Refer to the exhibit [Designated Area Posting](#). When PHS are in use, limit access to personnel that have completed Laboratory Standard (HP-IND-220) training or are under escort by Laboratory Standard Trained Personnel. When escorting untrained personnel, inform them of the Area Specific Hazards and Controls. [Hazard Communication \(HP-IND-200\)](#) or [Laboratory Standard \(HP-IND-220\)](#) training.
- Place "Danger" signs with the OSHA Regulated Chemical name and "Regulated Area- Authorized Personnel Only" in labs where OSHA Regulated Chemicals (see Definitions) have been determined to be present in the air above the action level (or PEL when not action level is prescribed by OSHA). Limit access to Authorized personnel that have completed

9. When planning to ship chemicals from BNL to an off-site location

- Place a label that meets the OSHA Requirements for the contents of a Manufacturer's Chemical Container Label  on the container.
- Include a Safety Data Sheet that meets the OSHA Requirements for the contents of a Safety Data Sheet with the shipment. If a chemical has been created at BNL, for which a SDS does not already exist, a SDS needs to be prepared. Contact the Chemical Hygiene Officer (Chemical Safety SME) for assistance in generating the required document. The chemical owner needs to provide information on the composition and physical properties of the substance so that a SDS can be prepared. The preparation of a Safety Data Sheet requires an extensive literature search for toxicological and physical properties and hazards.

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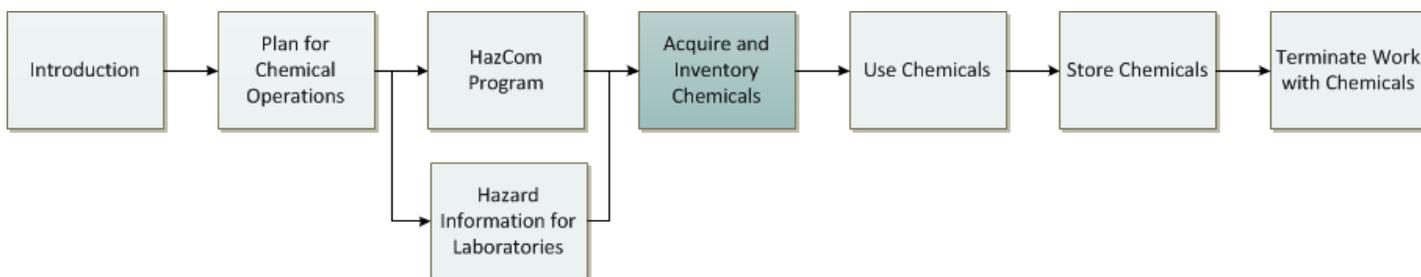
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SUBJECT AREA PROCEDURE CONTENT



Chemical Safety Subject Area
Effective Date: **Nov 24, 2015** ([Rev 22.1](#))
Periodic Review Due: **Oct 29, 2019**



For staff who acquire and manage chemicals in laboratory, industrial, and construction settings.

Acquire and Inventory Chemicals

1. Purchase chemicals through one of the following approved chemical acquisition processes:
 - Place a web requisition order. See the [Chemical Management System \(CMS\)](#) web page for Chemical Requisition information;
 - Use a credit card to purchase chemicals only from CMS-approved vendors (contact the [CMS Team](#));
 - Place an order with Procurement and Property Management (PPM) Stock.
 - Use an open purchase order if approved for the department in cooperation with CMS.

Some organizations may require approval for purchase of chemicals. Contact your [ES&H Coordinator](#).

2. If chemicals are acquired by other methods (e.g., sponsor-provided chemicals, samples, chemicals from off-site researchers), follow the Work Planning and Control process (see the [Work Planning and Control for Experiments and Operations](#) Subject Area) and CMS inventory process (see the CMS [Web Transactions and Forms](#) web page).
3. Whenever possible, order the smallest quantity of chemical to meet immediate needs. Avoid purchasing more than needed to get a volume discount. This practice reduces the hazard levels in an area and may reduce waste disposal costs when the chemical is no longer needed. Substitute a safer chemical when possible. A [Safety & Health Representative](#) can be consulted to provide assistance to identify substitute chemicals.
4. Maintain the BNL CMS chemical inventory by adding and deleting chemical containers as the status changes.
 1.
 - Refer to the CMS [What Chemicals Need to Be Inventoried in the CMS](#) web page for information on chemicals that must be entered into the CMS database;
 - Refer to the CMS [Web Transactions and Forms](#) web page.

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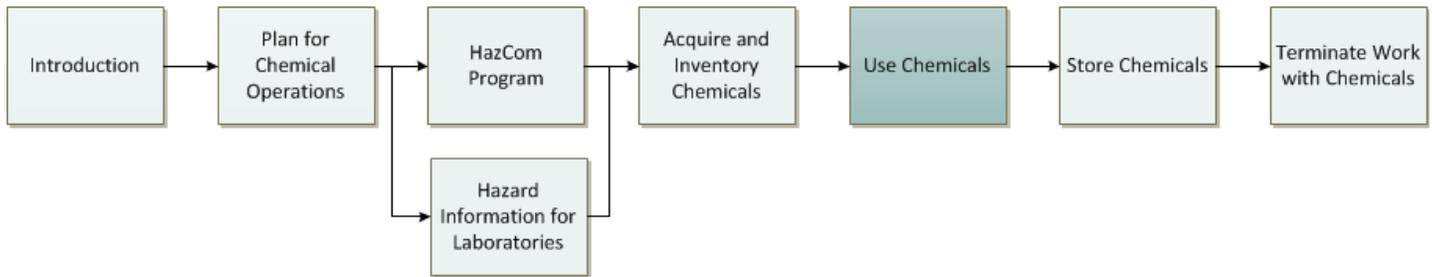
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Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))

Periodic Review Due: **Oct 29, 2019**



For staff who supervise chemical users or who are assigned to use chemicals in a laboratory, industrial, and construction/maintenance projects.

Use Chemicals

1. Observe good hygiene practices regarding food, beverage, and cosmetics in HazCom Areas and laboratories:
 - Do not consume food, candy, or beverages in areas with chemicals;
 - Do not apply cosmetics in these areas;
 - Do not use glassware or utensils used with chemicals to prepare food;
 - Do not smoke within any BNL building;
 - Remove jewelry when there is a potential for contact with electrical sources and/or laboratory equipment with moving parts.
2. Use engineering controls, administrative controls, and personal protective equipment to ensure worker exposure to chemicals is below occupational exposure limits. Have the Safety & Health Representative (or line organization approved ESH professional with an industrial hygiene background) evaluate the need for exposure measurements.

In the laboratory setting

 - Nonhazardous chemical operations may be done on lab benches, i.e., operations that have negligible risk to eye, skin, or inhalation exposure (i.e., no potential to create airborne levels of chemicals above ambient levels).
 - Limit work with hazardous chemicals on laboratory benches to operations such as opening packing boxes, preparing labels for containers, and handling closed containers of chemicals.
 - Use exhaust ventilation (laboratory hood, glove box, "snorkel" [i.e., local exhaust ventilation]) when handling chemicals in a manner with potential to exceed occupational exposure limits, especially OSHA Particularly Hazardous Substances (i.e., acute toxins, carcinogens, or reproductive toxins), sensitizers, volatile toxic liquids, organic liquids or solvents, airborne particulates (e.g., dust), or liquid aerosols of even moderately toxic chemicals.
 - Use exhaust ventilation when pouring concentrated acids and base solutions; discharging gases/vapors from vacuum pumps and distillation columns; and discharging harmful gases and vapors from drying ovens and muffle furnaces.
 - Use means to prevent air contact such as glove boxes or gas cabinet for operations with air reactive chemicals, such as alkali metals and pyrophoric materials.
3. Follow standard operating procedures (SOPs) relevant to safety and health for laboratory work with hazardous chemicals, such as
 - Procedures found in the section [Experimental Safety Review](#) in the [Work Planning and Control for Experiments and Operations](#) Subject Area;
 - SOPs and operator aids developed by line organizations;
 - Recommendations listed on the [ESH Guide: Chemicals](#) web site:
 - Recommended Procedures for Handling Health & Physical Hazards
 - Recommended Procedures for Operations and Equipment involving Hazardous Chemicals
 - Guidance: Good Practices in Chemical Operations in laboratories Recommendations
4. Conduct operations with chemicals in compliance with these subject areas, as applicable:

- [Asbestos](#) (see the section [Scientific Laboratory-scale Use of Asbestos](#))
- [Beryllium](#)
- [Compressed Gas Cylinders and Related Systems](#)
- [Confined Spaces](#)
- [Cryogenics Safety](#)
- [Explosives Safety](#) (Non-exempt Quantities of Commercial Detonable Materials)
- [Fire Safety](#) (contains requirements for Combustible, Flammable, Hydrogen systems, Oxidizers, Pyrophoric and Combustible Metals, Welding, Cutting and other Hot Work)
- [Pressure Safety](#)

5. Use Personal Protective Equipment for chemicals as prescribed in the following:

- Area-based PPE requirements in the [Personal Protective Equipment and Respirators](#) Subject Area;
 - Operation/task-based PPE requirements in the [Personal Protective Equipment and Respirators](#) Subject Area;
 - The exhibit [Personal Protective Equipment Requirements for Working with Chemicals](#) in this subject area; and
 - Work Planning and Control documents (such as an SOP, ESR, Job Risk Assessment [JRA], Facility/Area Risk Assessment, Work Permit).
- If the PPE requirements are not described in any of the above sources, have an ESH professional perform a workplace assessment and prepare a written PPE Selection Certification on the [Operation-Based Protective Clothing Selection Form](#), or other appropriate document.

Maintain PPE for eyes, face, head, and extremities in a sanitary and reliable condition and report problems with PPE to Principal Investigator or Supervisor immediately.

6. Handle chemicals safely to prevent spills and accidents:

- When moving chemicals within buildings, use a containment tray or chemical carrier for moving liquids, when practical.
- When moving chemicals between buildings, follow the [Movement by Vehicle of Hazardous and Radiological Materials On-site](#) Subject Area.
- When moving chemicals off-site, follow the [Transportation of Hazardous and Radiological Materials Off-site](#) Subject Area.

7. Use and store Explosives, Organic Peroxide- Class UD, Oxidizer- Class 4, Pyrophoric, and Unstable (reactive)- Class 4 or Class 3 detonable (based on Fire Code of New York State and NFPA 5000) only in a building 100% equipped with an automatic sprinkler system. Check with [Fire Protection Engineering](#) if there is any question on the status of a building.

8. Ensure ovens, furnaces, environmental chambers, and other heated enclosures used to heat flammable or combustible liquids, aerosols or gases are designed or modified to prevent internal explosion. Microwave ovens and refrigerators are possible ignition sources that need to be considered. Equipment must meet OSHA and NFPA requirements for electrical safety and explosion prevention.

- Microwave oven must be certified/listed/labeled to be safe by a nationally recognized testing laboratory (NRTL) by a standard that includes laboratory use. OSHA does not require a specific UL approval code. Microwave ovens must be used & installed in accordance with instructions included in the listing or labeling.
- All heating of flammable or combustible liquids that evolve during drying operations should be vented to avoid ignition.
- Equipment such as ovens, furnaces, environmental chambers, and other heated enclosures used to heat, store, or test flammable or combustible liquids or aerosols containing flammable gases must be designed or modified to prevent internal explosion.

9. Ensure that workers report to the OMC for required medical surveillance when

- Worker exposure exceeds an occupational exposure limit (OSHA/ACGIH);
- Workers exhibit signs or symptoms associated with chemical exposure; or
- Workers receive significant exposure from a chemical spill or leak.

When OSHA Regulated Chemicals are used in a manner that may result in potential exposure above Action Levels, Supervisors indicate the work on the Job Assessment Form (JAF) at the OMC (see the [Occupational Medicine Clinic](#) homepage, [Job Assessment \[JAF\] & Additional Medical Surveillance \[AMS\] Forms](#)). A second form, Additional Medical Surveillance (AMS) Form, is used to request OMC surveillance for those items not on the JAF (see the [Occupational Medicine Clinic](#) homepage, [Job Assessment \[JAF\] & Additional Medical Surveillance \[AMS\] Forms](#)). These evaluations can be done at the time of the scheduled examination, on request, or at any time. For more information on medical surveillance triggers, see Definition, Criteria, and Additional Information for JAF & AMS.

Consult a [Safety & Health Representative](#) (or line organization approved ESH professional with Industrial Hygiene background) for an assessment regarding chemical exposures and regulatory exposure levels.

10. Protect the environment from spills, follow the requirements in the subject areas below:

- [Storage and Transfer of Hazardous and Nonhazardous Materials](#);
- [Pollution Prevention and Waste Minimization](#);
- [Spill Response](#); and

- [Emergency Preparedness](#).

Guidance

Administrative controls include work procedures (safety policies, rules, supervision, schedules, and rehearsals) that reduce the duration, frequency, and severity of exposure to hazardous chemicals or situations. Although administrative controls can be used to control worker exposure, they are prone to human error and cannot be relied upon to reduce exposure all the time. Additional control mechanisms such as substitution of less hazardous materials/procedures, engineering controls and personal protective equipment (PPE) may be required to address worker exposure to the hazard(s). Some specific examples of administrative controls include

- Performing maintenance operations that involve toxic substances at night when the usual production workers are not present.
- Rotating workers through various job assignments so that their exposure time is lessened.
- Rehearsing complex work operations to improve the speed and safety.

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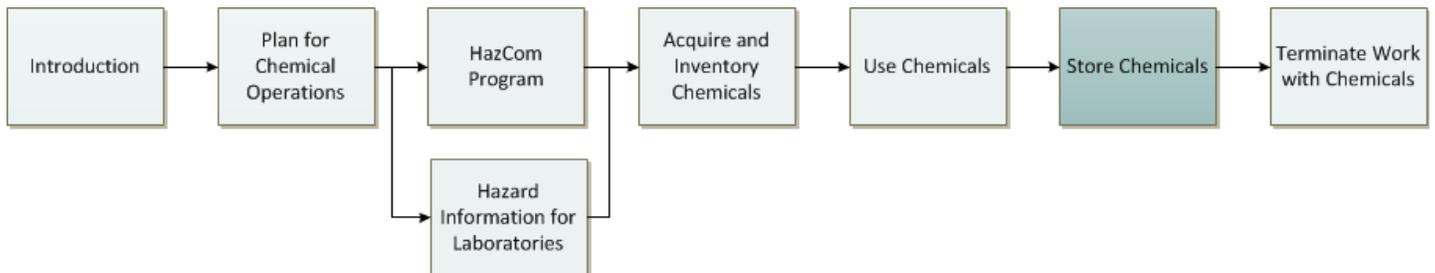
Questions/Comments

SUBJECT AREA PROCEDURE CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))
Periodic Review Due: **Oct 29, 2019**



For staff who supervise chemical users or who use chemicals in a laboratory, industrial, and construction/maintenance projects.

Store Chemicals

1. Store chemicals to avoid accidental consumption of chemicals or contamination of food:
 - Do not store food or beverages in the laboratory refrigerator. Label refrigerators used for storing chemicals or samples with words such as: "Chemicals Only - Do Not Store Food or Beverages in This Refrigerator".
 - Do not store chemicals in food or beverage refrigerators in break rooms, kitchens, and offices. Label refrigerators used for food with words such as: "Food Only - Do Not Store Chemicals in This Refrigerator".
2. Store chemicals to protect them from hazardous situations:

- To avoid fires and facility damage, store hydrogen, combustible, flammable, pyrophoric, and oxidizer chemicals as required in the [Fire Safety](#) Subject Area.
- Store Explosives, Organic Peroxide- Class UD, Oxidizer- Class 4, Pyrophoric, and Unstable (reactive)- Class 4 or Class 3 detonable (based on Fire Code of New York State and NFPA 5000) only in a building 100% equipped with an automatic sprinkler system. Check with the Fire Protection Engineer if there is any question on the status of a building.
- Note location on fire run card and hazard information placard for storage of
 - flammable solids > 40 pounds;
 - flammable liquids > gallons;
 - flammable gases > 10 pounds;
- Store flammable liquids in glass, metal or polyethylene safety cans approved for such storage (UL listed or FM approved, e.g., Self-closing cap, automatic vent, and flame arrester; Current carrying insert embedded into the can for proper grounding and a funnel).

Maximum Size of Containers for Combustible and Flammable Fluids					
Class	Flammable liquids			Combustible liquids	
	1A	1B	1C	II	III
Glass	1 pta	1 qta	1 gal	1 gal	5 gal
Metal (other than Department of Transportation (DOT) drums)	1 gal	5 gal	5 gal	5 gal	5 gal
Safety cans b	2 gal	5 gal	5 gal	5 gal	5 gal
Metal drums (DOT specifications)	60 gal	60 gal	60 gal	60 gal	60 gal
Approved portable tanks	660 gal	660 gal	660 gal	660 gal	660 gal

- For chemicals and mixtures that can cause over-pressurization and rupture the container, take provisions to prevent failure. For example:
 - Handle and dispose of corrosive etch solutions to prevent over-pressurization failure of the containers from the evolving gases. Consult the procedure [Physical Hazards: Corrosive Etch Operation Over-Pressurizations](#) on the [ESH Guide: Chemicals](#) website, or use equivalent control measures.
 - Ensure peroxide forming compounds are safely stored by periodically testing for peroxide formation or use of another method that prevents the formation of peroxides. Consult the procedure [Physical Hazards: Peroxide Forming Compound Testing](#) on the [ESH Guide: Chemicals](#) website for guidance on peroxide formation testing protocols and removal techniques.
- Store combustible metal waste in separate non-combustible containers and empty the containers from the work place daily. Ensure proper disposal through the Environmental Protection Division.
- Ensure refrigerators and freezers for storing flammable liquids are designed, constructed, approved, and labeled for that purpose. Ordinary refrigerators and freezers even if modified to remove spark sources are not acceptable. For more information on chemical refrigerators/freezers, consult the procedure [Cooling Devices](#) on the [ESH Guide: Chemicals](#) website).
 - Do not place flammable materials in household (domestic-type) refrigerators.
 - Use only explosion-proof or flammable material refrigerators for storage of these chemicals.
 - All refrigerators located in laboratory areas must be clearly marked as "For chemical use only".
- Protect against hazardous interactions with incompatible chemicals. Consult the [ESH Guide: Chemicals](#) web site recommendations on:
 - [Chemical Storage General Recommendations](#)
 - [Chemical Storage - Compatible Groups & Color Coding](#)
 - [Mineral acid/Carboxylic Acid Storage Recommendations](#)

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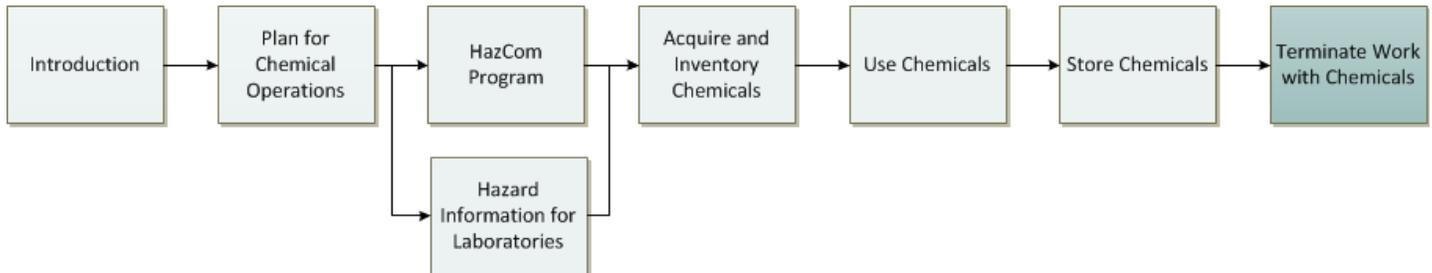
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SUBJECT AREA PROCEDURE CONTENT



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For staff who supervise chemical users or who use chemicals.

Terminate Work with Chemicals

1. When equipment is to be transferred off-site, excessed, loaned to an off-site organization, or disposed and it has the potential for chemical surface contamination, have it evaluated for the presence of surface level above acceptable levels by the [Safety & Health Representative](#). Process knowledge may be used to determine potential contamination.
2. When a chemical use area is to be reused as a non-chemical area (such as an office, lunch room, conference room, or storage) or will be demolished, have the area evaluated for the presence of surface level of chemicals by the [Safety & Health Representative](#).
3. If mercury droplets are found, contact a [Safety & Health Representative](#) to determine the exposure and appropriate spill-response actions.
4. If perchloric acid has been used in a laboratory hood, have surface wipe samples taken before disassembling the ventilation equipment and ducting.
5. In laboratories where OSHA Particularly Hazardous Substances (e.g., Carcinogens, Reproductive Hazards, Highly Acute Toxins [including toxins of biological origin]) have been used, follow this decontamination procedure, or an equivalent:
 - Remove equipment, supplies, products, and materials such as apparatuses, thermometers, gas cylinders, medical waste containers, sharps containers, sharps (needles and razor blades), trash, and other miscellaneous lab or shop material prior to vacating the space.
 - Remove visible residues, standing liquids, loose particulate material (whether known or unknown material) on floors, bench tops, shelves, inside drawers, cabinets, refrigerators, surfaces of local exhaust enclosures (e.g., chemical fume hoods and glove boxes) and any other potentially contaminated surfaces and any equipment that is to be moved.
 - Wipe surfaces down with mild detergents such as soap and water.
 - Take surface wipe samples taken before removing designated area postings. Contact a [Safety & Health Representative](#) for assistance in sampling.
 - Compare measured surface levels to DOE and OSHA regulatory housekeeping and clearance levels, and BNL (SHSD) recommended surface levels.
 - Determine action(s) needed to release the area for planned future use.
 - When surface levels are below regulatory limits and all stored chemicals have been moved, remove designated area postings.
6. When a chemical is no longer needed for operations, follow the provisions for waste disposal in the [Hazardous Waste Management](#) Subject Area.

Guidance

All surfaces and equipment should be cleaned and put into a safe condition prior to vacating, transferring or relocating laboratory

and shop spaces. Clearing laboratory and shop spaces of debris and contamination prior to transfer of ownership safeguards the personnel who work in these areas during space or building demolition, renovation, and construction activities. It also prevents delays in renovation and demolition schedules.

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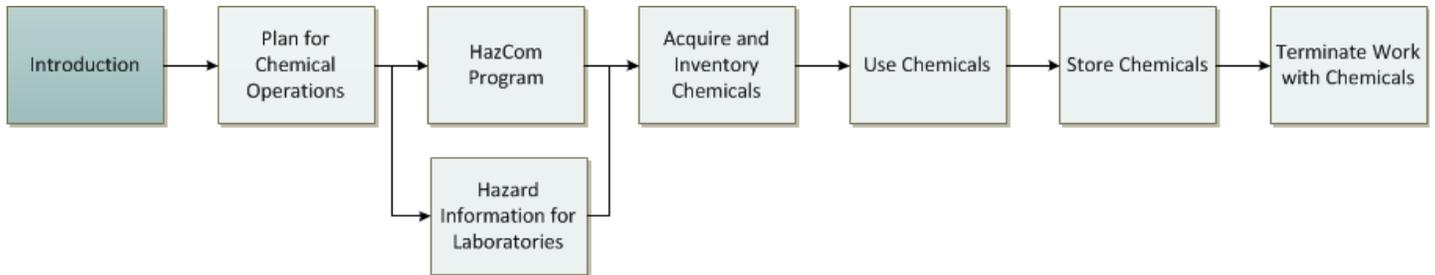
REQUIREMENTS CONTENT



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Reporting Obligations

None

External/Internal Requirements

BNL has to abide by all applicable Prime Contract clauses, DOE directives, industry standards, as well as Federal, state, and local laws. BNL develops its policies and procedures based on an evaluation of these external requirements. This Subject Area implements the following requirements:

Requirement Number	Requirement Title
10 CFR 851	Worker Safety and Health Program
20 CFR Parts 1 and 30 (EEOICPA)	Interim Final Rule Implementing the Energy Employees Occupational Illness Compensation Program Act (EEOICPA)
29 CFR 1910	Labor/Occupational Safety and Health Standards
29 CFR 1926	Labor/Safety and Health Regulations for Construction
40 CFR 370	Protection of the Environment/Hazardous Chemical Reporting: Community Right-to-Know
ACGIH TLVs	Threshold Limit Values for Chemical Substances and Physical Agents
ANSI Z 87.1; ANSI/ISEA Z 87.1	Occupational and Educational Personal Eye and Face Protection Devices [1968:IBR 29 CFR 1926.102; 1968, 1989 & 2003: IBR 1910.113, 133, 252]
BSA Contract No. DE-SC0012704 - Clause C.4	Statement Of Work
BSA Contract No. DE-SC0012704 - Clause H.27 (ACT)	Non-Federal Agreements for Commercializing Technology (Pilot) (ACT)
BSA Contract No. DE-SC0012704 - Clause H.3	Contractor Assurance System
BSA Contract No. DE-SC0012704 - Clause I.131 (DEAR 970.5223-1)	INTEGRATION OF ENVIRONMENT, SAFETY, AND HEALTH INTO WORK PLANNING AND EXECUTION (DEC 2000)

BSA Contract No. DE-SC0012704 - Clause I.51	Hazardous Material Identification And Material Safety Data (jan 1997) (alt 1 Jul 1995)
DHHS CDC NIH 12th Report on Carcinogens (RoC) [IBR 29 CFR 1910.1200]	National Toxicology Program: Carcinogen - Annual Report; [IBR 29 CFR 1910.1200]
DOE-STD-1066-99	Fire Protection Design Criteria
O 151.1C	Comprehensive Emergency Management System
O 414.1D Admin Chg 1 (May 8, 2013)	Quality Assurance
P 434.1A (Nov 7, 2013)	Conduct and Approval of Select Agent and Toxin Work at Department of Energy Sites.
P 456.1	Secretarial Policy Statement on Nanoscale Safety
United Nations WHO - IARC Monograph Series [IBR 1910.1200]	International Agency on Research on Cancer (IARC) Monographs on Carcinogen: IARC List Vol 1-104 [IBR 1910.1200]

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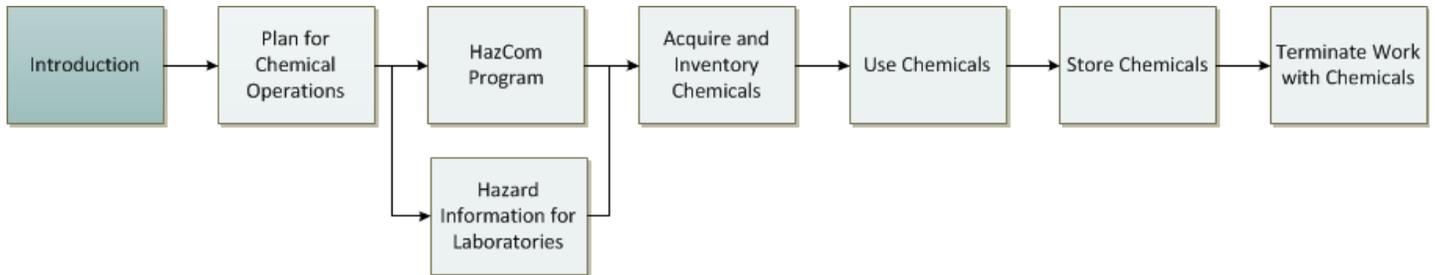
TRAINING CONTENT



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Training

Provide workers with chemical hazard training at the time of their initial assignment and whenever a new chemical hazard is introduced by taking the [Hazard Communication \(HP-IND-200\)](#) web course (or equivalent). HP-IND-200 provides information on hazardous chemicals by covering categories of hazards (e.g., flammability, carcinogenicity). Alternative training classes that address specific chemicals can be used if that format is judged to be more effective.

Training needs to be approved by the Chemical Hygiene Officer and must include the following criteria: requirements of the OSHA Hazard Communication Standard; availability of the written hazard communication program; accessing the required list(s) of hazardous chemicals and Safety Data Sheets (SDS); and methods to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.).

For more information on chemical safety training, contact the Department/Division [Training Coordinator](#) or see the [Training and Qualifications](#) Web site.

Provide training to those working with the following chemicals or operations via these classes:

- [Beryllium Use at BNL \(TO-BERYLLIUM1\)](#)
- [Chemical Protective Clothing User Training \(HP-OSH-157\)](#)
- [Cadmium Training for HazCom Operations \(TO-CADMIUM\)](#)
- [Compressed Gas Safety \(TO-COMPGAS1\)](#)
- [Corrosive Etch Solutions \(TO-CORETCH\)](#)
- [Cryogen Safety \(HP-OSH-025\)](#)
- [Hazardous Waste Generator \(HP-RCRIGEN3\)](#)
- [Methylene Chloride Training for HazCom Operations \(TO-MCAT\)](#)
- [Nanotechnology for Support Personnel \(TO-NC-HS1\)](#)
- [Spill Prevention, Control, and Countermeasure \(TO-SPCC\)](#)
- [Transportation of Hazardous Material \(TO-HAZMAT-A\)](#)

The following optional web classes are available to help workers improve their understanding of chemical safety:

- [Area-Based PPE & Hazard Information Placarding \(TO-AREA-PPE\)](#)

- [Fire Extinguisher Safety \(TO-FIRE-EXT\)](#)

Provide workers access to information on reproductive hazards via the BNL training courses [Hazard Communication \(HP-IND-200\)](#) and [Lead in the Workplace \(TO-LEAD1\)](#).

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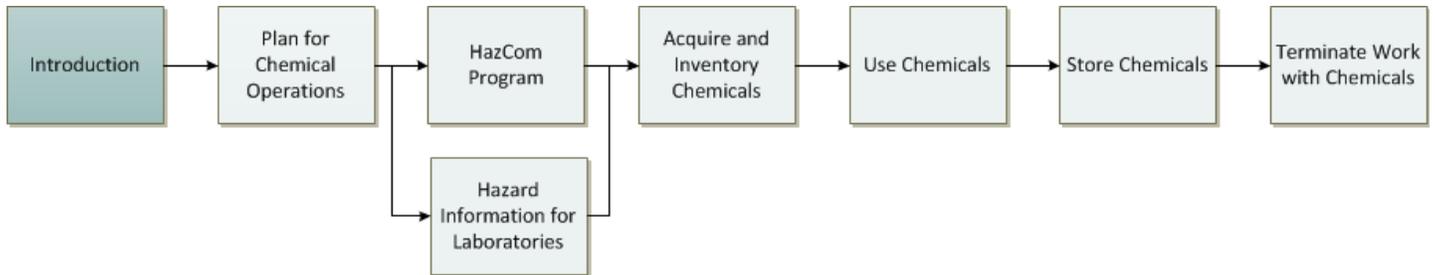
CHANGES CONTENT



Chemical Safety Subject Area

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Revision History

Revision Number	Revision Type	Revision Date	Revision Description
22.1	Minor	11/24/2015	The exhibit Permanent Procedure for Interim Administrative Controls in Case of Eyewash or Safety Showers Pathway Deficiencies was removed from the subject area. It was replaced by the "Guidance on Ensuring an Unobstructed Pathway to Eyewashes and Showers When Working With Corrosives" on the ESH Directorate's ESH Guide: Chemicals website and the revised wording clarifies that the document is guidance and not a requirement.
22.0	Major	10/29/2015	Links to the recommended procedures "Physical Hazards: Corrosive Etch Operation Over-Pressurizations" and "Physical Hazards: Peroxide Forming Compound Testing" on the ESH Directorate's <i>ESH Guide: Chemicals</i> website were re-established in the section Store Chemicals. These recommended procedures specifically address the safe handling of chemicals and mixtures that can cause over-pressurization and rupture the container. All implementation actions have been completed.
21.1	Minor	02/10/2015	References and links were updated to reflect the migration of recommended procedures to the ESH Guide: Chemicals web site.
21.0	Major	10/29/2014	The subject area was completely reviewed, revised, and published in the new layout. The following significant changes were made to better align actions based on regulatory requirements from those based on best management practices: <ul style="list-style-type: none"> • The "Chemical Hygiene Plan" exhibit was removed and converted into seven procedure sections. • The exhibit "Examples of Proper Flammable Cabinet Location in Typical Laboratory Suites" was created using the same requirements that were formerly in the "Chemical Hygiene Plan" exhibit; • The following exhibits and form ("BNL Chemical Storage Recommendations", "Chemical Resistance Chart", and "HF Burn First Aid Directions") were removed from the subject area and migrated to the Chemical Safety Program Area page on the Safety and Health Services Division (SHSD) web site. That site provides BNL's best management practices on chemical safety. • The "HF Burn Kit Inspection Form" was eliminated. It is replaced with an electronic surveillance database on the SHSD web pages. • The Definitions section was revised to retain only those terms directly applicable to this subject area.
20.1	Minor	08/07/2014	As a minor revision, the exhibit Chemical Hygiene Plan, Chapter 10.0 Medical Consultation and Medical Surveillance, was updated to add guidance for medical examinations and consultation that documents an existing policy.

20.0	Major	04/22/2014	The exhibit Chemical Hygiene Plan was modified to add guidance on the use of snorkel hoods for chemical operations in laboratories.
19.0	Major	12/30/2013	The exhibit Chemical Hygiene Plan was revised to remove best management practices in Chapter 6 for certain chemical hazards. The text was replaced with links to the Safety & Health Services Division's (SHSD) Chemical Safety web page where the requirements and recommendations have been converted into Recommended Procedures for Specific Chemical Hazards & Operations. All hazards in the OSHA Global Harmonized System (GHS) are addressed in the SHSD's Chemical Safety web page (ATS 7156.2.14).
18.0	Major	04/30/2013	The Chemical Hygiene Plan was revised as a major revision to assign expiration dates to Group D peroxide forming compounds.
17.0	Major	01/04/2013	As a major revision and part of a corrective action, the Chemical Hygiene Plan, section 6.1B Etching Solutions (formerly Corrosive Etching Solutions), was revised to update requirements on etching solutions and add the Inspection Checklist for Etching Operations.
16.1	Minor	09/28/2012	As a minor revision to the subject area, the exhibit HF Burn First Aid Directions and the HF Burn Kit Inspection Form were updated to address the addition of eye wash solutions to the contents of the HF Burn Kit.
16.0	Major	05/08/2012	<p>This was a major revision to revise the exhibit Chemical Hygiene Plan and the following changes were made:</p> <ul style="list-style-type: none"> • Section 6.1.B was updated with new wording to address waste disposal; • Section 9.0 Emergency Procedures and Equipment and the table for BNL Eyewash & Safety Shower Recommendations for Activation were updated; • The Table of Contents was updated to reflect the changes made to the exhibit. <p>The exhibit Permanent Procedure for Interim Administrative Controls in Case of Eyewash or Safety Showers Pathway Deficiencies was revised to add a "Sample of Hazard Information Placard", which replaces the previous signage "Sample Signs for Posting Entrances to Areas with Deficient Pathways".</p>
15.0	Major	03/20/2012	<p>This was a major revision and the section Planning, Acquiring, Storing, Synthesizing, Transporting, and Using Chemicals was revised to add the following new step:</p> <p>During work planning, a Safety & Health Representative performs an assessment of potential occupational exposure and determines the need for exposure monitoring for compliance with occupational exposure limits (ACGIH and OSHA).</p> <p>The Guidelines section in the same procedure was added to transfer the following information pertaining to reproductive hazards (from the rescinded Reproductive Hazards Subject Area): BNL training courses, basic chemical hygiene practices, and pregnant laboratory workers who may discuss the work they perform with their personal physicians to determine if any work restrictions are necessary.</p> <p>The Chemical Hygiene Plan was updated to revise disposal requirements for corrosive etch solutions and add information in the following areas:</p> <ul style="list-style-type: none"> • Peroxide forming compound testing • Flammable cabinet inspection • Chemical leak detection • Eyewash activation • Use and storage of unstable (reactive) Class 4 or Class 3 detonable chemicals • HF burn kit inspection program.
14.0	Major	07/29/2011	The exhibit Designated Area Posting was updated to reflect the appropriate format of the Signal word and wording on the sign.
13.0	Major	04/29/2011	The Chemical Hygiene Plan was revised to ensure Human Performance principles were emphasized in section 6.1.B. Corrosive Etching Solutions.
12.0	Major	02/25/2011	<p>The subject area was completely reviewed and the following changes were made:</p> <ul style="list-style-type: none"> • The form HF Burn Kit Inspection Form and the exhibit BNL Chemical Storage Recommendations were added • The exhibit HF Burn Kit Contents was removed • The exhibits HF First Aid Directions and PPE Requirements for Working with Chemicals were revised • In the exhibit Chemical Hygiene Plan, <ul style="list-style-type: none"> • the description of the hierarchy of controls was updated; • Chapter 5, Personal Protective Equipment, was revised to include Area-based PPE requirements;

			<ul style="list-style-type: none"> • Chapter 6.1.A, Hydrofluoric Acid, was expanded to include more information on burn kit inspections and first aid; • Chapter 6.1.B, Corrosive Etching Solutions, was added to provide requirements and guidance on piranha etch, aqua regia, nochromix, and other corrosive etching solutions; • Chapter 6.3, Explosive Chemicals, was revised to direct the list of explosive chemicals to the CMS Web site; • Chapter 6.7, Peroxide Forming Substances, was revised to address peroxide forming compound testing, expiration dates, vented bottles, and segregation; • Chapter 6.9, Heated Temperature Baths, was added to address requirements and guidance for oil and salt baths; • Chapter 7, Chemical Storage, was revised to link to the new BNL Chemical Storage Recommendations exhibit.
11.0	Major	10/19/2010	This was a major revision to Chapter 4 in the Chemical Hygiene Plan to define the scope of chemical operations after normal business hours that require special attention to safety. The new Unattended Chemical Experiment Form and Instructions was added to document unattended chemical experiments (operations).
10.1	Minor	08/10/2010	The Chemical Hygiene Plan was reformatted with bookmarks to improve document navigability and links were added in section 6.2 to tables listing BNL Carcinogens, BNL Reproductive Toxins, and BNL Highly Acute Toxins.
10.0	Major	07/29/2010	In response to the 2010 Industrial Hygiene Multiple Topic Self-Assessment, Section 6.7A: Materials Likely to Form Peroxides in Storage in the exhibit Chemical Hygiene Plan was revised as follows: Butadiene; Chloroprene; Tetrafluoroethylene; Divinyl ether, Potassium (metal), Potassium amide, and Sodium Amide (Sodamide), and the footnote "a when stored as liquid monomer" were added to List A; Acetaldehyde; Benzyl alcohol; 2-Butanol; and Dioxanes (p-dioxane, 1,4-dioxane) were added to List B; and Vinyl acetylene, Vinyl Chloride, Butadiene (as gas), Chlorotrifluoroethylene (as Gas), and Tetrafluoroethylene (as Gas) were added to List C.
9.5	Minor	05/11/2010	The following specification was added to the Definitions section and Appendix A1: Glossary of Terms in the Chemical Hygiene Plan: As per 10 CFR 851, the value published in the ACGIH 2005 Threshold Limits Values for Chemical Substances and Physical Agents & Biological Exposure Indices is observed at BNL.
9.4	Minor	10/06/2009	The exhibit Designated Area Posting was revised in the correct ANSI format and the following terminology on the posting was updated to align with the subject area: "Reproductive Substance" was changed to "Reproductive Toxin" and "Particularly Hazardous Chemical" was changed to "Particularly Hazardous Substance".
9.3	Minor	09/18/2009	The exhibit Permanent Procedure for Interim Administrative Controls in Case of Eyewash or Safety Showers Pathway Deficiencies was added to the subject area after it was inadvertently deleted in a previous revision. A link to the exhibit was added to page 59 in the Chemical Hygiene Plan. The exhibits Highly Acute Toxin Sign, Carcinogen Sign, and Reproductive Toxin Sign were deleted and replaced by the Designated Area Posting in a previous revision. The reference to NFPA 30 Flammable and Combustible Liquids Code was deleted.
9.2	Minor	08/27/2009	The text for Fig. 2, section 7, in the Chemical Hygiene Plan was changed from "Fig. 2 shows an entirely different situation. The interior lab passage is now a required egress route for exiting the area. It should not have any flammable cabinets or other storage against the walls in the Egress Route that restricts egress in any manner." It now reads "Fig. 2 shows an entirely different situation. The interior lab passage is now a required egress route for exiting the area. It should not have any flammable cabinets. No other storage against the walls in the Egress Route is allowed if it restricts egress in any manner."
9.1	Minor	08/24/2009	Section 7 Chemical Storage in the Chemical Hygiene Plan was updated to clarify language only. No new requirements were added. Wording on where flammable cabinets can and cannot be placed was clarified. Figures 1 and 2, Laboratory Suite Example and Separate Laboratory Suite Example, were added to show that egress routes must not contain flammable cabinets.
9.0	Major	06/18/2009	This was a major revision and review and changes were made to close out the corrective action for ISM/Safety Improvement Project Plan Corrective Action, Corrective Action C-1.2 – Review and revise SBMS documents and HPI concerns. The subject area was re-titled Chemical Safety. The section Planning, Acquiring, Storing, Synthesizing, Transporting, and Using Chemicals (formerly titled Determining the Applicability of the Hazard Communication Program or the Chemical Hygiene Plan for Laboratories) was revised and incorporates the primary steps and program requirements from the deleted sections Using the Chemical Hygiene Plan in Laboratories (Lab Standard) and Using the Hazard Communication Plan for Working With Chemicals in HazCom Operations. The new exhibit Chemical Hygiene Plan (CHP) provides detailed information and includes procedural requirements to meet OSHA regulations. The CHP links to the new exhibit Chemical Resistance Chart and the new exhibit Designated Area Posting, which was added to provide for posting multiple hazards in laboratories. The following exhibits were deleted from the subject area: Handbook on Chemical Use in HazCom Operations; Handbook on Chemical Use in

			Laboratories; and Storing Materials That Might Become Hazardous During Prolonged Storage. The following changes were made in the Definitions section: the definitions for compressed gas, cryogenics (was changed from cryogenic liquids), and explosive (was changed from explosives) were revised. The term and definition for nanomaterial was added.
8.0	Major	05/21/2009	The exhibit Personal Protective Equipment Requirements for Working with Chemicals was added as part of the corrective action for ISM/Safety Improvement Project Plan Corrective Action, Corrective Action C-1.2 – Review and revise SBMS documents and HPI concerns, to specify the minimum personal protective equipment required when handling chemicals.
7.0	Major	02/27/2009	This was a major revision and changes were made to the Hydrofluoric Acid (HF) section in the exhibit Handbook on Chemical Use in Laboratories to align Occupational Medicine Clinic (OMC) and the Safety and Health Services Division's Industrial Hygiene (IH) Group requirements for HF exposure controls, initial first aid burn treatment, the requirement of first aid HF burn kits, and the transport of patients via EMS with OMC to the Hospital were documented. PPE requirements for work with HF were revised. Required contents of HF Burn Kits were standardized and a program for the inspection of HF burn kits and replacement of dated material in the burn kits was provided for. The new exhibits HF Burn First Aid Directions and HF Burn Kit Contents were added to the subject area.
6.3	Minor	10/21/2008	As an opportunity for improvement resulting from an OHSAS Audit, the following changes were made for clarification: In the subsection Planning to Use Chemicals in Laboratories (see the section Using the Chemical Hygiene Plan in Laboratories [Lab Standard]), step 3 was revised to include the hierarchy of controls to keep exposures below the specified occupational exposure limits. In the subsection Planning to Use Chemicals for HazCom Operations (see the section Using the Hazard Communication Plan for Working with Chemicals in HazCom Operations), step 3 was revised to include the hierarchy of controls to keep exposures below the specified occupational exposure limits.
6.2	Minor	09/10/2008	In the exhibit Handbook on Chemical Use in Laboratories, links were removed from the acid compatibility table. A minor correction was made to the last bulleted item on page 5 of the exhibit Storing Materials That Might Become Hazardous During Prolonged Storage.
6.1	Minor	08/01/2008	The Table of Contents page in the Handbook on Chemical Use in HazCom Operations was reformatted for accuracy. The Table of Contents page in the Handbook on Chemical Use in Laboratories was reformatted for accuracy, Appendix A - Chemical Compatibility Table for Chemical Storage in Laboratories was moved to the back of the handbook, and references were updated.
6.0	Major	06/16/2008	This is a major revision to correct deficiencies resulting from the BHSO Surveillance of HazMat Storage. The new exhibit Storing Materials That Might Become Hazardous During Prolonged Storage was created from the exhibit Handbook on Chemical Use in Laboratories to make the testing and labeling of peroxide forming compounds a requirement. Changes were made to decrease the period between testing of peroxide forming compounds from 12 months to 6 months. A step was added to section 2.7 Storing Chemicals in Laboratories and section 3.4 Storing Chemicals for HazCom Operations to include a link to the new exhibit. In the exhibit Handbook on Chemical Use in Laboratories, the Chemical Storage in Laboratories section was updated and reorganized to provide clearer guidance on chemical compatibility and storing chemicals; a new section on suggested organization for proper segregation on acids was added; and an appendix was added to include chemical compatibility guidance and suggested storage organization to maintain proper segregation.
5.0	Major	05/16/2008	Major changes were made to address BNL procedures for engineered nanomaterials and to link to the Interim Procedure Approach to Nanomaterial ESH. A new subsection on "Working with Nanomaterials in Laboratories" was added to the section "Using the Chemical Hygiene Plan in Laboratories (Lab Standard)." New steps were added to the subsection "Using Hazardous Chemicals in HazCom Operations" in the section "Using the Hazard Communication Plan for Working with Chemicals in HazCom Operations" for hazard communication operations with nanomaterial.
4.10	Minor	03/17/2008	Minor change to update links.
4.9	Minor	09/27/2007	Minor change to Highly Acute Toxin Sign.
4.8	Minor	08/29/2007	In the section, Using the Chemical Hygiene Plan in Laboratories (Lab Standard), the subsection Planning to Use Chemicals in Laboratories was revised to include links to Additional Chemical Information on the Safety and Health Services Division Web Site. The subsection Using Hazardous Chemicals in Laboratories was revised to include links to the exhibit Lab Coat Ordering and Laundering in the Personal Protective Equipment Subject Area, which clarifies the process of lab coat laundering and purchasing.
4.7	Minor	08/27/2007	The exhibits Handbook on Chemical Use in HazCom Operations and the Handbook on Chemical Use in Laboratories were reformatted, revised, and the following changes were made: links to the BNL Chemical Storage Compatibility Table on the Safety & Health Services Division Web site were incorporated to provide updated information in the sections for chemical storage. The following exhibits were replaced with updated postings: Carcinogen Sign; Highly Acute Toxin Sign; and Reproductive Toxin Sign.

4.6	Minor	08/28/2006	This revision was made to address shortcomings in the original language that did not fully address the intent. This change clarifies the wording to identify who is authorized to access a designated area.
4.5	Minor	06/26/2006	Updated HazCom Operations and Lab Standard as follows: Updated CMS and MSDS links. Updated to reflect current CMS and MSDS operations Updated to provide references to online registration, deletions and transfers. Updated section on static inventory for clarity.
4.4	Minor	05/23/2006	Changed the wording from CMS Chemical Exchange to CMS Chemical Surplus Program.
4.3	Minor	02/15/2006	Revised as part of the Corrective Action Plan for findings from the FY2005 BHSO Industrial Hygiene Exposure Monitoring Assessment, to add or strengthen employee exposure monitoring requirements. This revision is to ensure that BNL requirements better delineate DOE and OSHA exposure monitoring requirements and expectations.
4.2	Minor	12/22/2005	The sections Using the Chemical Hygiene Plan in Laboratories (Lab Standard) and Using the Hazard Communication Plan for Working with Chemicals in HazCom Operations were revised to reflect process changes in interfacing with the Chemical Management System (CMS). Changes were made to the description on the data entry methods for credit cards and adding and deleting chemical container information into CMS. Links were updated to provide access to BNL references and other chemical safety information important to BNL operations. The links to the Industrial Hygiene Representative were changed to Safety & Health Representative. Minor formatting changes were made to the exhibit Handbook on Chemical Use in HazCom Operations and the exhibit Handbook on Chemical Use in Laboratories. Terms were removed from the exhibit Handbook on Chemical Use in HazCom Operations and added to the Definitions section. The definition for OSHA Laboratory Standard, as defined in 29 CFR 1010.1450, was added, and the definition for permissible exposure limits (PELs) was modified to include a link to PELs for air contaminants.
4.1	Minor	09/10/2004	The Eyewash Activation/Inspection Sign was replaced in the Handbook on Chemical Use in Laboratories (Lab Standard).
4.0	Major	06/02/2004	This revision replaces Interim Procedure, "Eyewash Fountains and Emergency Showers" and Environment, Safety and Health (ESH) Standard 2.2.1, Laboratory Workplace Standard for Nonradioactive Toxic Substances. All sections of this subject area are replaced with the following new sections: Determining the Applicability of the Hazard Communication Program or the Chemical Hygiene Plan for Laboratories Using the Chemical Hygiene Plan in Laboratories (Lab Standard), and Using the Hazard Communication Plan for Working With Chemicals in HazCom Operations The following handbooks are new: Handbook on Chemical Use in HazCom Operations and Handbook on Chemical Use in Laboratories Key changes and additions include: Eye Washes/Shower Policy "OSHA Particularly Hazardous Chemicals" Chemical Management System Perchlorates testing Reproductive and Highly Toxic Chemicals Hydrogen Fluoride Peroxidizable chemicals handling and testing NFPA Target Organ labeling
3.1	Minor	11/21/2003	Minor Change.
3.0	Major	12/15/2002	Step 4 of the section Using Hazardous Chemicals was revised to add the following requirement: Where the Permissible Exposure Limit (PEL) is exceeded, the person completing the hazard analysis with the concurrence of the PI/Supervisor, will ensure that a written compliance program is developed to reduce employee exposure below the PEL by means of engineering and/or work practice controls.
2.0	Major	04/11/2002	OSHA-regulated carcinogens (i.e., select carcinogens), reproductive toxins, and substances with a high degree of acute toxicity must be used with engineering controls (hood, glove box, or effective exhaust capturing equipment). Areas must be labeled with "Carcinogen", "Reproductive Hazard", or "Highly Acute Toxin" warning labels or signs. The Carcinogen Sign, Highly Acute Toxin Sign, and Reproductive Toxin Sign were added to this subject area for chemical users to print and post. See the exhibit on Rules of Laboratory Scale Use of Chemicals.
1.0	Major	10/01/2001	This subject area describes the guidelines and procedures for working with chemicals at Brookhaven National Laboratory (BNL). It provides information and links to many resources that are designed to aid BNL chemical users, who acquire, manage, use, supervise use, or store chemicals, with essential guidance for chemical safety. It encompasses all components of the BNL Chemical Safety Program, ranging from initial work planning process to disposal. This subject area replaces ES&H Standards 2.1.0, Hazard Communication Program and 2.1.1, Laboratory Chemical Hygiene Plan.

NOTE: The dates for "Major Revisions" match the Subject Area Effective Date. Major and/or Minor revisions may not always match with the "Last Modified Date", since this date could reflect changes to links or spelling. Records of changes are maintained in the SBMS documentation for each subject area.

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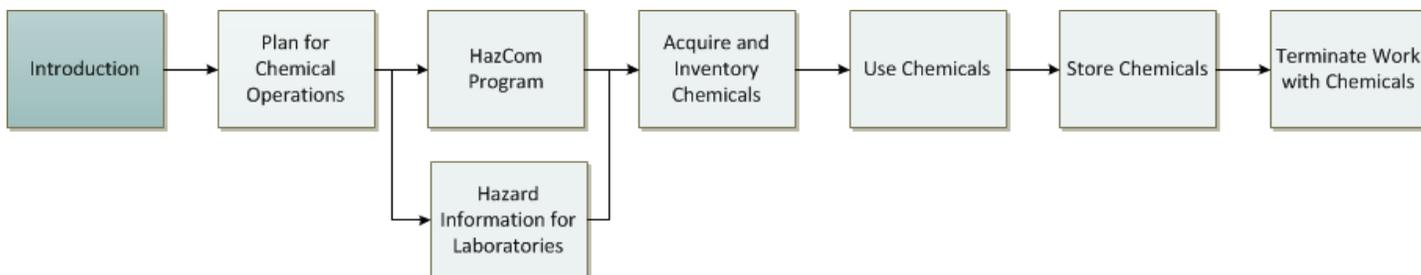
DEFINITION CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))

Periodic Review Due: **Oct 29, 2019**



Definitions

Term	Definition
Chemical Hygiene Plan	A written program developed and implemented by BNL to set forth procedure, equipment, and work practices that protect employees from the health and safety hazards presented by hazardous chemicals in laboratory settings.
Chemical Management System (CMS)	BNL's chemical management system that enables retrieval of MSDS, chemical forms, location of chemicals and chemical contact persons, communication with the CMS team, and other information on chemicals and chemical resources.
consumer product	A product or hazardous substance, as defined in the Consumer Product Safety Act and Federal Hazardous Substances Act used for the purpose intended by the chemical manufacturer or importer, in a duration and frequency of exposure which is not greater than the range of exposures that could reasonably be experienced by consumers for the purpose intended.
exposure	Contact with a chemical, biological, radiological, or physical hazard. Exposures may be acute (large doses over a short period) or chronic (small doses over a long period).
Hazard Communication (HazCom) area	An area, such as shop, workroom, accelerator facility, and similar areas where non-administrative and non-laboratory activities with chemicals are performed.
hazardous chemical	Any chemical that poses a physical or health hazard as defined in 29 CFR 1910.1200 or by BNL's Chemical Hygiene Officer.
HazCom operation	A job in which a worker such as accelerator operator, mechanic, printer, custodian and similar roles, performs operations with chemicals.
OSHA Regulated Chemical	A chemical regulated in 29 CFR 1910.1001 to 1052: Coal tar pitch volatiles; 13 Carcinogens (4-Nitrobiphenyl, etc.); alpha-Naphthylamine; Methyl chloromethyl ether; 3,3'-Dichlorobenzidine (and its salts); bis-Chloromethyl ether; beta-Naphthylamine; Benzidine; 4-Aminodiphenyl; Ethyleneimine; beta-Propiolactone; 2-Acetylaminofluorene; 4-Dimethylaminoazobenzene; N-Nitrosodimethylamine; Vinyl chloride; Inorganic arsenic; Lead; Chromium (VI); Cadmium; Benzene; 1,2-dibromo-3-chloropropane; Acrylonitrile; Ethylene oxide; Formaldehyde; Methylenedianiline; 1,3-Butadiene; and Methylene Chloride.
pictogram	OSHA icons for chemical, health, and physical hazards. Listed in Section G of the exhibit Design Specifications for Environmental, Health and Safety (ESH) Sign, Placard, and Labels in the Sign, Labels, and Placards for ESH Subject Area

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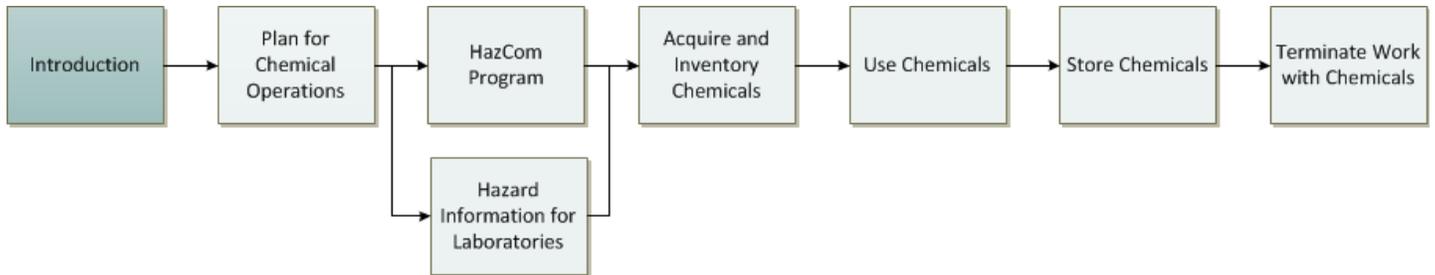
LESSONS LEARNED CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))

Periodic Review Due: **Oct 29, 2019**



Lessons Learned

BNL's Lessons Learned Program supports ongoing learning by collecting and sharing work experiences and good practices. This allows us to better understand risks and hazards and develop strategies to control them. Many managers share selected Lessons Learned with their staff at daily briefings and morning meetings to update everyone's knowledge and skills. The Program draws information from BNL, the DOE complex, and private industry. For more, [see the BNL Lessons Learned Program website](#).

Here is a selection of recent Lessons Learned related to this particular Subject Area:

Title	Date
Chemical Container Failure Due to Over-Pressurization	Apr 26 2010
From the U.S. CSB: Key Lessons for Preventing Incidents from Flammable Chemicals in Educational Demonstrations	Nov 09 2015
From US Chemical Safety Board: Warning Against Use of Methanol During Laboratory and Classroom Combustion Demonstrations	Sep 22 2014
Liquid chemical bottle from the manufacturer found at BNL with improper, non-sealing cap. (Caution, from the BNL Center for Functional Nanomaterials)	Jul 30 2014
Proactive Discovery of a Bottle of Potentially Explosive Material	Oct 30 2015
Proper Life Cycle Management of Time and Condition Sensitive Chemicals is Critical to Avoid Possible Container Over-pressurization and Failure	Mar 15 2013
Selecting Gloves to Avoid Potential Chemical Breakthrough	Apr 14 2010

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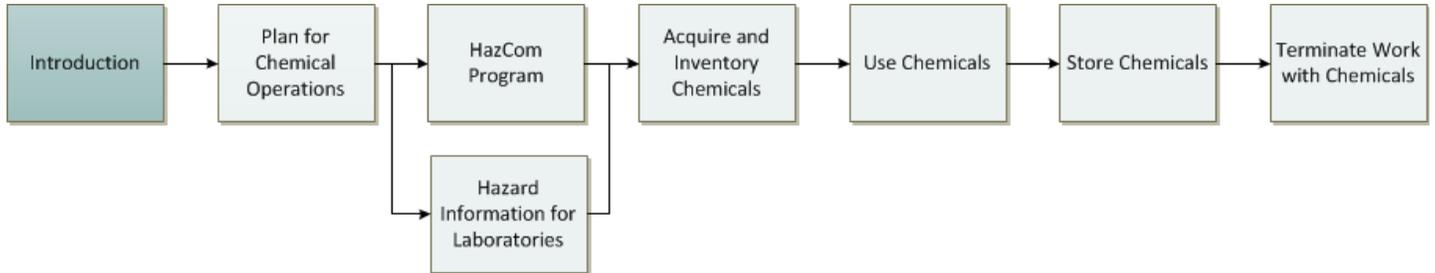
Questions/Comments

FORMS/EXHIBITS CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))
Periodic Review Due: **Oct 29, 2019**



Designated Area Posting

Effective Date: **Oct 29, 2014**

The Designated Area Posting is provided as a [PDF](#).

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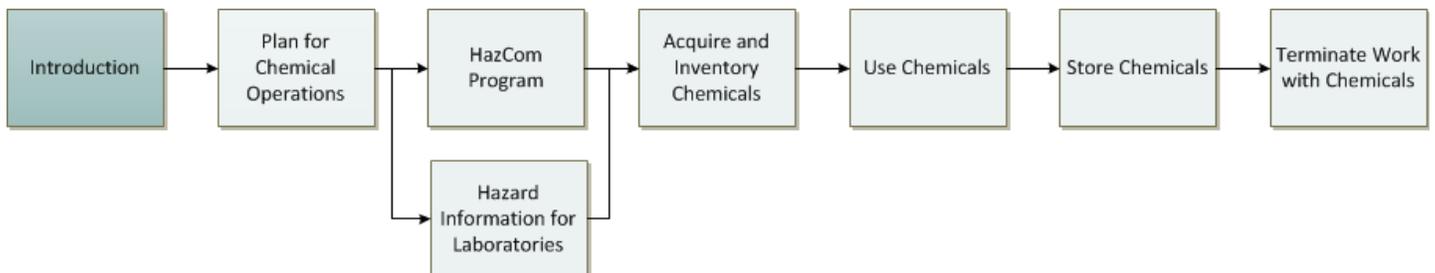
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FORMS/EXHIBITS CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))
Periodic Review Due: **Oct 29, 2019**



Examples of Proper Flammable Cabinet Location in Typical Laboratory Suites

Effective Date: **Oct 29, 2014**

The exhibit Examples of Proper Flammable Cabinet Location in Typical Laboratory Suites is provided as a [PDF](#) file.

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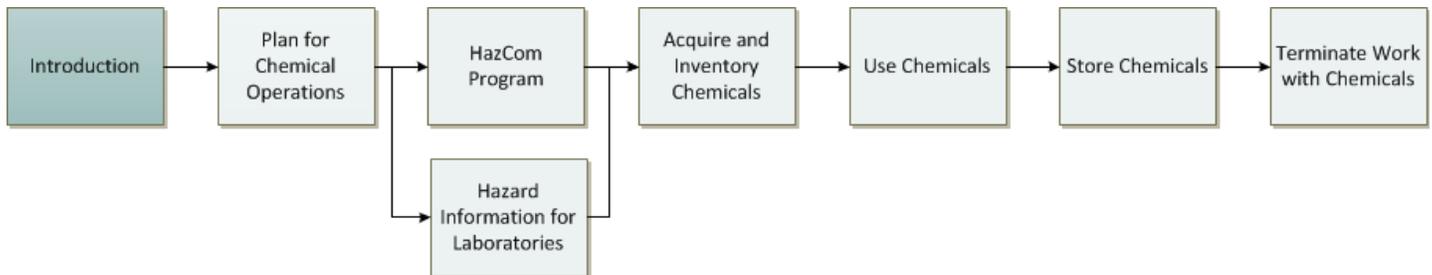
FORMS/EXHIBITS CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))

Periodic Review Due: **Oct 29, 2019**



Personal Protective Equipment Requirements for Working with Chemicals

Effective Date: **Oct 29, 2014**

Personal Protective Equipment Requirements for Working with Chemicals is provided as a [PDF](#) file.

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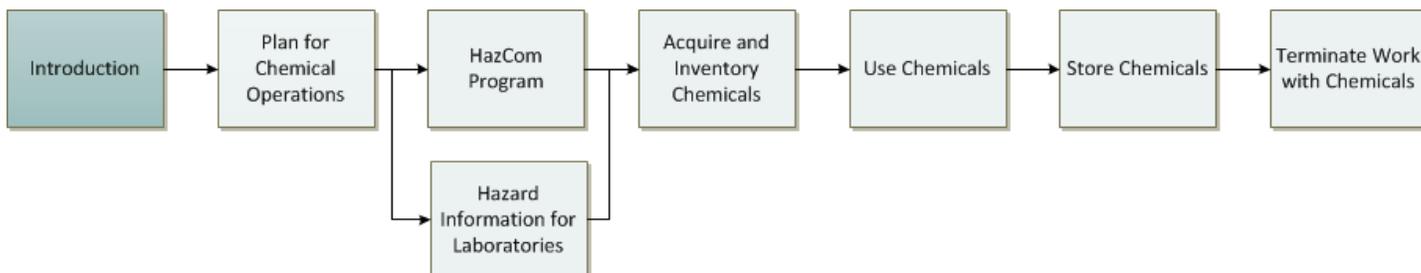
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FORMS/EXHIBITS CONTENT



Chemical Safety Subject Area

Effective Date: **Nov 24, 2015** ([Rev 22.1](#))
Periodic Review Due: **Oct 29, 2019**



Unattended Chemical Experiment Form and Instructions

Effective Date: **Oct 29, 2014**

The Unattended Chemical Experiment Form is provided as a [PDF](#) file.

Unattended Chemical Experiment Instructions

Follow these instructions when it is necessary for experimental apparatus to be left unattended outside normal working hours. An Unattended Chemical Experiment is a hazardous chemical operation in a laboratory conducted outside of the normal business hours of the organization when no one in the area is knowledgeable of the experiment and its hazards.

Responsibilities:

- Do not leave hazardous chemical operations unattended without the consent of the Principal Investigator or designee.
- Principal Investigator or designee determines the need for completing and posting the Unattended Chemical Experiment Form based on the hazards of the operation.
- When an experiment is to be left unattended, complete the Unattended Chemical Experiment Form, which identifies the hazards and sets emergency actions and shutdown steps.
- Post the form at the main entrance to the experimental area. For larger labs/rooms, also display form close to the experimental set-up.
- If personnel will be in the laboratory during the period you are away, inform them of any hazards, what to look out for, and any precautions.
- Leave instructions on how to shut down the experiment in the event of a fire or other accident, interruption of services (such as water or electric), or monitoring alarms.

Guidance:

1. If using water-cooling, use properly wired or clipped-on plastic tubing connections.
2. When an experiment is left running in a fume hood, pull the sash down as far as practical.
3. Do not leave baths using hydrocarbon oil unattended. Use baths with silicone oil for unattended operation.
4. Avoid unattended distilling of highly flammable solvents.

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