A. Purpose

This policy establishes safe work procedures for personnel working with hydrofluoric acid (HF), a highly hazardous chemical. It outlines safe work practices and response in case of an emergency to minimize health risks.

B. Applicability/scope

This policy applies to personnel working in a Columbia University laboratory and support areas located at Columbia University Medical Center (CUMC), Morningside campus (MS), Lamont-Doherty Earth Observatory (LDEO), and Nevis. This policy covers all users of HF, Facilities workers, and first-responders to incidents involving a HF releases.

C. Definitions

Hydrofluoric Acid (HF) is an inorganic acid which is derived from dissolving hydrogen fluoride in water. HF is a noncombustible, colorless, fuming liquid or gas with a strong, irritating odor and has a permissible exposure limit (PEL) of 3 ppm in air. HF readily dissolves in water to form colorless hydrofluoric acid solutions; dilute solutions are visibly indistinguishable from water. It is present in a variety of over-the-counter products at concentrations of 6% to 12%.

Synonyms include hydrogen fluoride, fluoric acid, hydrofluoride, and fluorine monohydride.

Although hydrofluoric acid is a weak acid compared with most other mineral acids, it can produce serious health effects by any route of exposure. HF is extremely corrosive and will attack all tissues of the body. These effects are due to the fluoride ion's aggressive, destructive penetration of tissues. Exposure to high concentrations of HF may result in systemic toxicity due to calcium channel disruption.

Additionally, the fluoride ion in HF has an affinity for calcium and magnesium, two minerals that are essential for bodily health. As the fluoride binds with calcium, it consumes the body’s supply of this mineral in the blood and also attacks bone structure, forming calcium fluoride salts. As calcium levels are depleted in the blood, a condition known as hypocalcaemia, organ failure begins to occur, heart function becomes erratic and can eventually fail, resulting in death.

D. Procedures

1. Engineering Controls

Chemical Fume Hood: All use of HF requires the presence of proper engineering controls. HF should always be handled inside a properly functioning chemical fume hood that is identified with signage indicating HF is used in the area. Before use, always confirm the fume hood is certified and working properly; check sash function and visually assess airflow by taping a tissue to the base of the sash to observe airflow, sufficient airflow should be able to pull the tissue inward. This is known as a Kimwipe test. Procedures involving even small quantities of dilute HF solutions must not be performed on the lab bench. Avoid older fume hoods with soapstone work surfaces. Prevent contamination of the work surfaces by placing plastic trays or bench paper on the work surface before starting HF procedures. There may also be special design considerations based on the

concentrations and/or volumes of HF being used or the frequency of use. For an exposure assessment, contact EH&S.

2. **Administrative Controls**
   a. Purchasing: Before purchasing, it is suggested that researchers evaluate possible substitutes for Hydrofluoric Acid. HF should be purchased in quantities which limit amounts in storage. Work with quantities that allow for quick and easy clean up by appropriate personnel if a spill occurs
   b. Storage: Store HF in a cool and dry place away from incompatible materials separated from other chemicals. **NEVER STORE HF IN GLASS CONTAINERS**! Hydrofluoric acid reacts with many materials therefore avoid contact with glass, concrete, metals, water, oxidizers, reducers, alkalis, combustibles, organics and ceramics. HF must be stored in tightly closed containers made of polyethylene. Secondary containment of polyethylene must also be used. Protect containers from physical damage. Storage facilities should have adequate ventilation and be constructed for safe containment of acids.
   c. Hydrofluoric acid is an extremely hazardous material. Lab personnel should utilize a buddy system and never work alone. For safety reasons, the use of HF by University staff or students should preferably be limited to regular working hours. Any changes in procedures must be discussed with a supervisor. To determine lab specific needs, EH&S is available to provide an assessment to address these needs. Changes to procedures will be reflected in the lab specific SOP, where applicable. Only persons who have read and understood this document and who are suitably trained should be allowed to use this substance.
   d. Do not eat, smoke, drink, chew gum, or apply cosmetics (including lip balm and hand lotion) where HF is handled or used. Wash hands thoroughly with soap and water after handling HF.

3. **PPE**
   a. Gloves: Working in a fume hood protects the worker from inhalation exposure and, to a certain extent, splashes but the hands are still vulnerable to HF exposure. HF readily penetrates skin and can become trapped under fingernails. Heavy neoprene, thick nitrile rubber, or butyl gloves are best for working with HF (note that HF attacks natural rubber); however, the increased thickness of the gloves reduces dexterity, increasing the possibility of spills. Wear two pairs of nitrile exam gloves at a time, changing the outer pair often. When working with larger quantities of HF in procedures that do not require as much dexterity, wear heavy nitrile or neoprene rubber gloves, with a nitrile exam glove worn under the outer glove. Confirm that all glove lengths are sufficient to cover any exposed skin between the wrists and lab coat cuffs.

b. Body Protection: When working with HF, wear clothing and personal protective equipment (PPE) that provides protection in the event of a spill: long-sleeved shirt, long pants, and closed shoes, in accordance with the University's PPE Policy. Always wear a lab coat, chemical-resistant neoprene apron and sleeves. **Do not wear shorts and sandals in laboratory.**
c. Eye Protection: Indirectly vented chemical goggles, along with a face shield, should be worn when handling HF to prevent eye/face exposure.

4. Emergency Measures During Exposure to Hydrofluoric Acid

a. **ALL HYDROFLUORIC ACID EXPOSURES ARE A MEDICAL EMERGENCY! IMMEDIATELY CONTACT HOSPITAL and CAMPUS SECURITY AND ARRANGE FOR IMMEDIATE MEDICAL TRANSPORT. A COPY OF THIS POLICY AND SDS MUST BE PROVIDED TO THE MEDICAL PERSONNEL.**
b. Avoid all types of exposure to HF (inhalation, ingestion, absorption, injection). When working, pay close attention to the task at hand and do not allow yourself to become distracted. Contact with dilute HF solutions may not produce immediate pain, but may result in severe burns hours later without immediate treatment.
c. Each laboratory containing HF should contain a "go-bag". Items to be included in the go-bag should be at a minimum:
   - A change of clothes and shoes in the event that the emergency shower is used
   - Two copies of the SDS
   - 2.5% Calcium gluconate gel
   - 1% Calcium gluconate eyewash solution
   - NOTE- HF emergency supplies can be purchased at numerous vendors including http://www.calgonate.com/
d. Skin Exposure: Rapid decontamination is critical to minimizing/preventing injury. If exposure occurs, remove contaminated clothing and immediately wash the affected area with copious amounts of water for 5 minutes. Have someone else call for medical assistance during this time. It is critical to apply 2.5 % calcium gluconate first aid gel to affected areas after washing with copious amounts of water for a minimum of 5 minutes. Don a new pair of gloves in order to avoid secondary HF burns while applying the calcium gluconate gel. Anyone who provides assistance should also use the appropriate PPE discussed in Section 3. Calcium gluconate binds HF and prevents it from penetrating deeper into tissues. In the unfavorable situation where calcium gluconate gel is not available, flushing with water should be continued for 15 minutes or until emergency medical assistance arrives.
e. Inhalation: Immediately remove victim to clean air until emergency personnel arrive on scene. Unlike external splashes, inhalation exposure is a serious medical

emergency and is more problematic because there are no immediate decontamination procedures. Call for immediate medical assistance. Keep person calm until medial help arrives.

f. Eye Exposure: Immediately flush eyes for at least 5 minutes with copious amounts of water, then switch to using 1% calcium gluconate solution as the flushing agent until emergency personnel arrive on scene. In case of unavailability of 1% calcium gluconate solution, keep flushing eyes with water until emergency medical assistance arrives. **Do not use calcium gluconate gel on the eyes.**

5. Waste Disposal Procedures

a. Spent HF solutions and unwanted HF are to be disposed of as hazardous waste through EH&S. Drain disposal is not allowed. Please refer disposal questions to Hazmat@columbia.edu.

6. Spill Management

a. All areas where HF is used must have a proper spill control kit. Small spills can be neutralized by covering with acid neutralizer/sodium bicarbonate, after free liquid has been absorbed with spill control pads/absorbents. Once the spill is contained isolate the room and leave the area immediately. Call EH&S for help during normal business hours or Public Safety after hours. Have a SDS available.

b. If it is a large spill immediately evacuate all persons in the area and close all doors. Any type of spill/accidental release of HF must be reported immediately to EH&S during working hours. If an exposure occurs, take the injured person to the local area hospital for further assessment and treatment by medical personnel. It is recommended that the person be accompanied by a buddy. If transport is not available an ambulance must be called; speed of treatment is of the essence.

E. Responsibilities

1. EH&S

a. Provide fume hood certification annually
b. Arrange disposal of unwanted HF and HF-containing wastes
c. Respond to and follow up on all spills and exposures involving HF
d. Provide training on the safe use of HF
e. Conduct assessments as needed to address lab specific needs for HF research
f. Provide assistance with the development of the lab specific HF standard operating procedure (SOP)
g. Review and update this policy as necessary

2. Principal Investigator

a. Ensure that all personnel review this policy and follow safe practices for work with HF
b. Ensure appropriate PPE is available at no cost to all employees
c. Ensure emergency response supplies, including stocks of calcium gluconate are on hand in case of emergency
d. Provide a HF Safety Data Sheet (SDS) in the immediate work area where HF is used

e. Ensure HF spill kit is stocked and present; and workers are knowledgeable on its location and use in case of a spill (NOTE- for LDEO, the safety department supplies all spill kits)
f. Report all HF spills and/or exposures to EH&S
g. Develop a lab specific HF standard operating procedure (SOP) to include:
   - Access control
   - Emergency procedures
   - Buddy system while working with HF

3. Laboratory Staff

a. Comply with the provisions of the HF policy, SOP and work practices instituted by the PI and Columbia University
b. Participate in initial training prior to work with HF and renew training every 2 years
c. Report all spills or potential exposures immediately to PI and EH&S; if after hours or EH&S cannot be reached, please contact Public Safety

4. Facilities

a. Adhere to the Chemical Fume Hood Maintenance Policy while following EH&S Clearance Procedures
b. Ensure employees responding to repair and emergencies are familiar with this policy and HF hazards and use appropriate PPE
c. Coordinate with PI for routine maintenance of fume hoods

F. Emergency contact

Campus	Hours	Faculty / Staff	Students	Public Safety Contact
CUMC	Business-Hours	Workforce Health & Safety- Harkness Pavilion First Floor (212) 305-7580	Student Health Services - 60 Haven Avenue (212) 305-3400	x305-7979
	After-Hours	NYPH Emergency Department - First Floor of the Vanderbilt Clinic (VC)	NYPH Emergency Department - First Floor of the Vanderbilt Clinic (VC)	
LDEO	Business-Hours	Nyack Hospital: 160 North Midland Avenue Nyack, NY 10960 (845) 348-2000		(845) 359-2900 or x555
	After-Hours			
Morningside	Business-Hours	St. Luke's Hospital 1111 Amsterdam Avenue at 114th St, New York	Student Health Services - John Jay Hall, 3rd and 4th Floors (212) 854-2284	x99
	After-Hours		St. Luke's Hospital 1111 Amsterdam Avenue at 114th St, New York	
Nevis	Business-Hours	St. John's Riverside Hospital Dobbs Ferry Pavilion 128 Ashford Avenue Dobbs Ferry, NY 10522 (914) 693-0700		(914) 591-2870
	After-Hours			

G. Medical Surveillance- N/A
H. Recordkeeping- N/A
I. Appendices- N/A
J. Forms
  a. http://hr.columbia.edu/forms-docs/department-accident-report
  b. https://cumc.co1.qualtrics.com/jfe/form/SV_6gqSpJrYyxX5lul
K. References
  a. http://www.atsdr.cdc.gov/mmg/mmg.asp?id=1142&tid=250
  b. https://ehs.princeton.edu/laboratory-research/chemical-safety/chemical-specific-protocols/hydrofluoric-acid
  c. https://chemistry.harvard.edu/files/chemistry/files/safe_use_of_hf_1.pdf
L. Acknowledgements- N/A