

CNS Laboratory User Protocol

Center for Nanoscale Systems (CNS)
Harvard University



Outline

Purposes

General Perspective

Laboratory Safety

Emergencies

Fire

Toxic Gas

Equipment Use

Contamination Control



Purpose of the Protocol

Safety

- Ensure a Safe Working Environment

Success

- Promote Successful Laboratory Operation

Satisfaction

- Communicate Operational Strategies that Satisfy User's Needs



General Perspective

This protocol provides general guidance and basic awareness

Successful laboratory maintenance really relies on individual user's understanding, participation and self-discipline

Everyone, whether faculty member, student user, or staff engineer, is equally important to the success of the protocol

Trust, understanding and shared responsibility among all users ensures the success of every user



Safety

Requirements for Laboratory Entry

- Must have completed all safety training and submitted associated forms to CNS office
- Must have certification for self-use of instrumentation in the room.
 - For G07(main cleanroom), G05, G06, B15A, and G07-SMCR must have certification for general room use.
- Cleanroom (G07) requires both scan in and scan out for occupancy tracking



Safety

Laboratory Video System

- All CNS main laboratory spaces have video cameras and recorders
- Used for remote monitoring during emergency
- Used to investigate safety violations



Safety

Chemical Work

- **Important Chemical Rule #1**
 - Absolutely **NO CHEMICAL WORK** can be done at CNS without Wetbench or other training.



Safety

New Chemical Request

- **New Chemicals:**
 - Do not bring any new chemicals (liquid or solid) into any CNS lab without permission
 - If you want to bring in any new chemical into the clean room, then you need to
 - Complete a Material Request Form (MRF-FM006). The MRF can be found on the CNS website under the user section under Forms.
 - Complete the form and attach a safety data sheet to it and then email to CNS admin at info@cns.fas.harvard.edu
 - Receive email approval of your FM006.



Safety

Chemical Storage

- **Chemical Storage and Labeling:**
 - Chemicals used in CNS labs must be stored inside appropriate cabinets
 - not drawers, lockers, tool boxes
 - All chemicals, either purchased or self-mixed, must be clearly labeled according to the Haz-Mat handling procedure
 - Owner's name, group, contact information, and date of storage must be clearly labeled on the container



Safety

Chemical Transportation

- Ensure chemicals are always transported in tightened screw-top containers
 - no open beakers
 - no foil lids
- Always use provided chemical carriers
 - bucket, cart
 - Carriers must provide secondary containment



Safety

Chemical Use

- Chemicals must be used in appropriate hoods and wet benches (No chemical use is allowed outside appropriate Wetbenches !).
- User must be certified to use hoods and benches by taking the following training
 - Wet bench training for cleanroom (LISE-G07)
 - B15A room training
 - G05 Bio Materials room training
 - G06 Chemical Nanotech room training
 - Soft Material Cleanroom (SMCR) Orientation



Safety

Handling of Chemicals

- **Chemical Use:**

- Chemicals can only be used inside the assigned acid/solvent benches and hoods
- When handling any amount of acid or base you must wear face-shield, safety glasses, yellow chemical gloves, and apron.
- Never leave any unattended chemicals on bench tops or other public areas
- At all times labels are required for all chemicals (including DI water). The label shall include the name of the material, owner's name, contact information and returning time clearly near the material in use.



Safety

Handling of Cryogenes

- Protective equipment is required for handling liquid nitrogen and liquid helium
 - Face shield or goggles
 - Blue Cryo Gloves



Safety

Chemical Spills

- In Case of Large Chemical Spills:

- Immediately report large chemical spills to Operations Center (OC) at 5-5560, AND safety representatives or CNS staff members.
- If spills outside of the wet bench, isolate spill using A frame chemical spill signs, inform others in the lab, evacuate area.
- Do not attempt to pick up any Hydrofluoric Acid or TMAH spills. Call 5-5560 and contact a CNS staff member **immediately**.

- In case of Small Chemical Spills in wet bench

- In metal solvent bench, wipe up with lab wipes.
- In plastic acid/base bench, hose down deck, dry with lab wipes



Safety

Chemical Waste

- **Chemical Waste:**
 - Follow the instructions of waste material handling procedure to discard waste chemicals (see labels on the benches)
 - For unclear items, contact a staff member first
 - Clearly label waste containers (use provided tags)
 - Don't reuse empty containers without permission
 - Don't put chemicals back into their original containers



Safety

Housekeeping

- General Perspective

- Keeping lab areas clean and organized is every users responsibility
- Enforcement procedures may be necessary to ensure safe and effective operations

- Public Areas

- Always clean up the working space after you finish
- Don't leave/store anything on public areas, such as machine tops, bench surfaces, on/under tables, etc., without permission from a staff member

- Items Belonging to Individuals

- Keep non-shared items, such as tool boxes, wafers, glassware, etc., in the storage area assigned to you when not in use



Safety Discipline I

- Violations of safety or operational policy threaten the safety of staff and users, and the integrity of equipment.
- Serious violations will result in immediate and perhaps permanent loss of laboratory access.



Safety

Discipline II

- For minor offenses an escalating discipline policy will be used:
 - First offense: Written warning to User and PI.
 - Second offense: User will be given a 5 day suspension (or longer) where no CNS facilities may be used and User's PI will be sent a note. User may be asked to repeat training and certification.
 - Third offense: User will be given a one month suspension (or longer) where no CNS facilities may be used and User's PI will be sent a note. User may be asked to repeat training and certification.



Safety Discipline III

- Examples of safety violations
 - Improper chemical handling
 - Improper use of PPE
 - Bringing unapproved samples/chemicals into CNS labs
 - Bypassing lab entry controls, for example by opening doors for other users
 - Bypassing equipment use controls, for example by sharing passwords



Safety

Environmental Protection

- Work to minimize unnecessary release of chemical into environment
- Use sparingly – only as much as you need
 - Solvents !
 - Photoresist !
- Keep covered except when in use to avoid excess evaporation



Emergencies Evacuations

- **General Perspective**

- Always follow the rules/protocols set by the university, then CNS
- In an emergency that requires evacuation, leave the all labs – including cleanroom immediately – don't try to de-gown first!

- **In Case of Building Fire Alarm**

- TGMS will disable hazardous gas distribution, and user can additionally push-in yellow Emergency Gas Off (EGO) switch near the exit of the labs
- Evacuated clean room immediately with clean room suit still on and meet outside in front of Pierce hall

- **Large Chemicals Spills**

- Immediately report large chemical spills to Operations Center (OC) at 5-5560, AND safety representatives or CNS staff members.



Emergencies

Toxic Gas Alarms 1

- **Blue Alarm**
 - Gas leak in a breathing zone.
- **Amber Alarm**
 - Gas leak in exhausted enclosures or loss of exhaust
 - no leak in breathing area



This is the sign which will be posted at each toxic strobe

Toxic Gas Alarm

If you see and/or hear the **Amber Alarm** leave the immediate area. Move to front lobby of LISE building and wait for further instruction from CNS Staff!

If see and/or hear the **Blue Alarm** leave building immediately. Meet in front of Pierce Hall & wait for further instruction from CNS Staff and Environmental Health and Safety!

CALL **5-5560** FROM NEAREST PHONE TO REPORT EMERGENCIES

Emergencies

Toxic Gas Alarms 2

In the Case of Amber (Yellow) Alarm

What has happened?

- High Level or Low-level toxic or combustible gas leakage in exhausted enclosure
- A gas leak has been detected inside a gas cabinet or gas distribution manifold inside the cleanroom or gas storage bunker.

What will TGMCS do?

- Trigger visible and audible toxic gas strobe to evacuate areas
- Send a message to CNS monitoring station and University Operation Center
- Shut down the gas at the source.

What should you do?

- Exit the cleanroom immediately through the gowning room.
- Do not re-enter area until given an all-clear notice from CNS staff or University official.



Emergencies

Toxic Gas Alarms 3

In the Case of Blue Visual and Audio Alarm

What has happened?

- Low-level or High-level toxic or combustible gas leakage in breathing zone

What will TGMS do?

- Trigger blue toxic gas strobe
- Send a message to both CNS monitoring station and University Operation Center
- Shut down the gas at source

What should you do?

- Immediately evacuate from the LISE building, and proceed to Pierce Lawn Assembly Area. Do not leave the assembly area until notified to do so by local emergency responders.
- Immediately report the incident to CNS staff



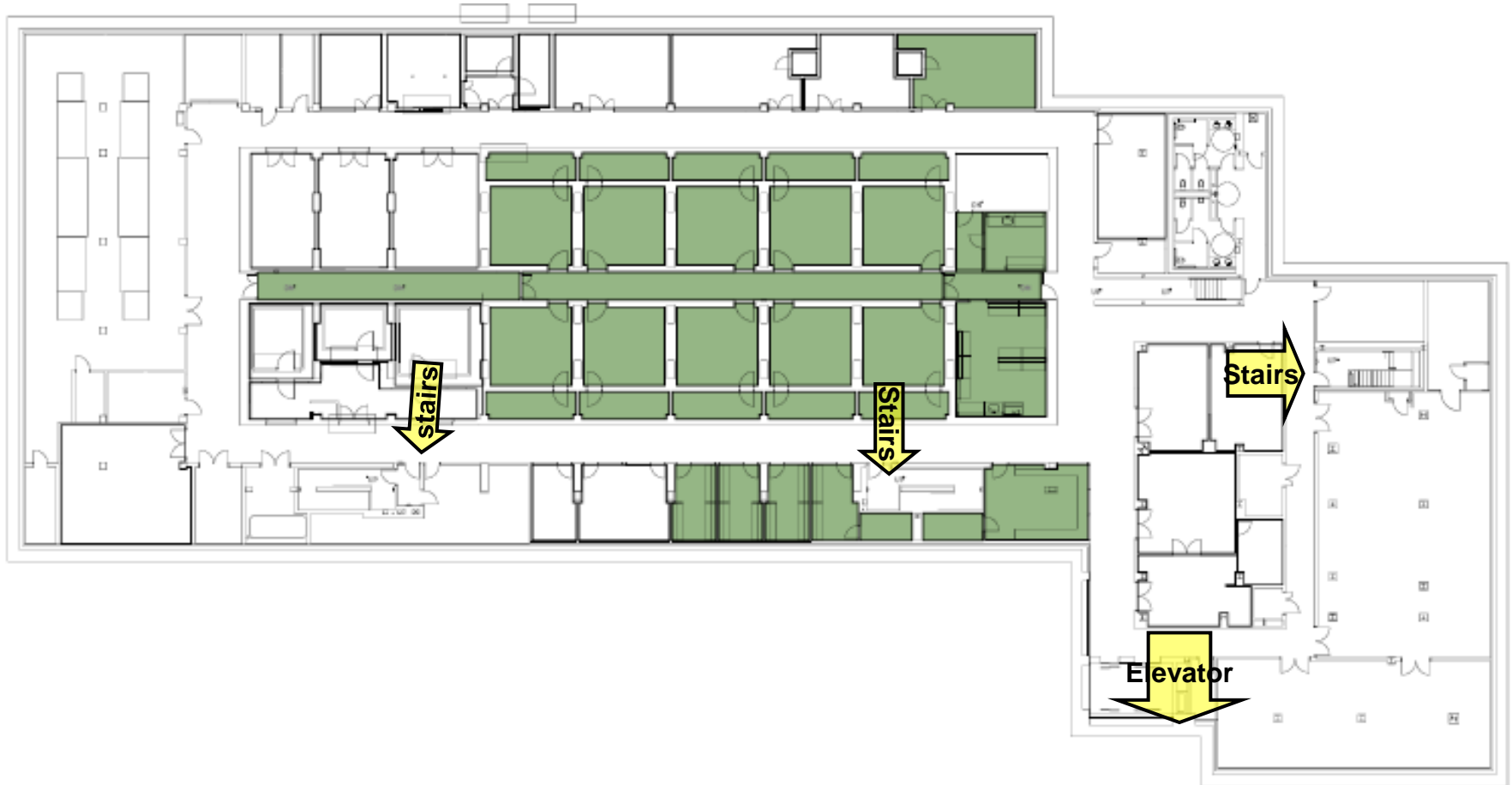
Emergencies

Exits & Safety Equipment

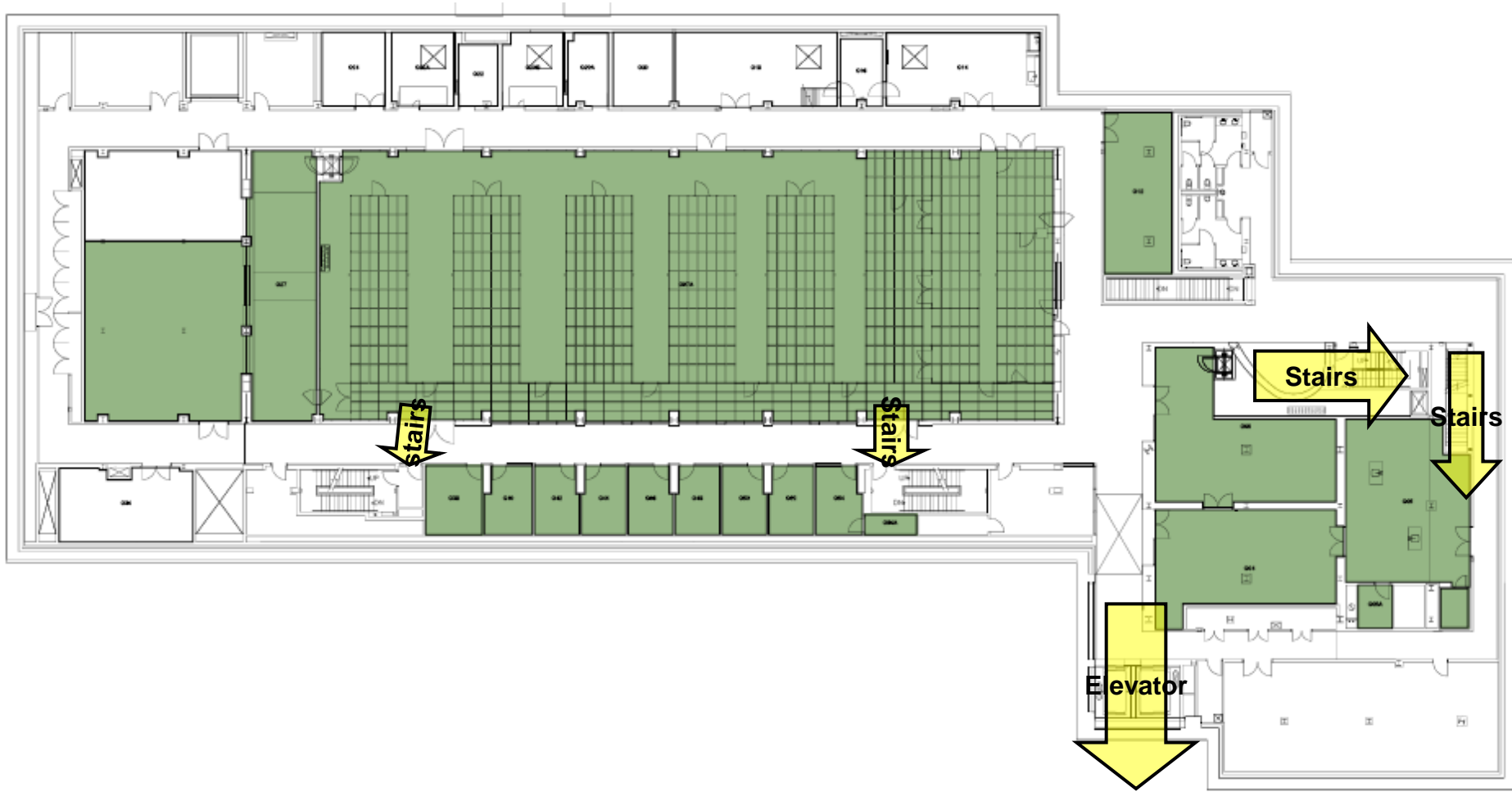
- Know how to get to any emergency eye wash and shower blind-folded.
- Find each exit in the laboratory and know how to reach the nearest stairwell in corridor
- Once outside meet in front of Pierce Hall during emergencies.



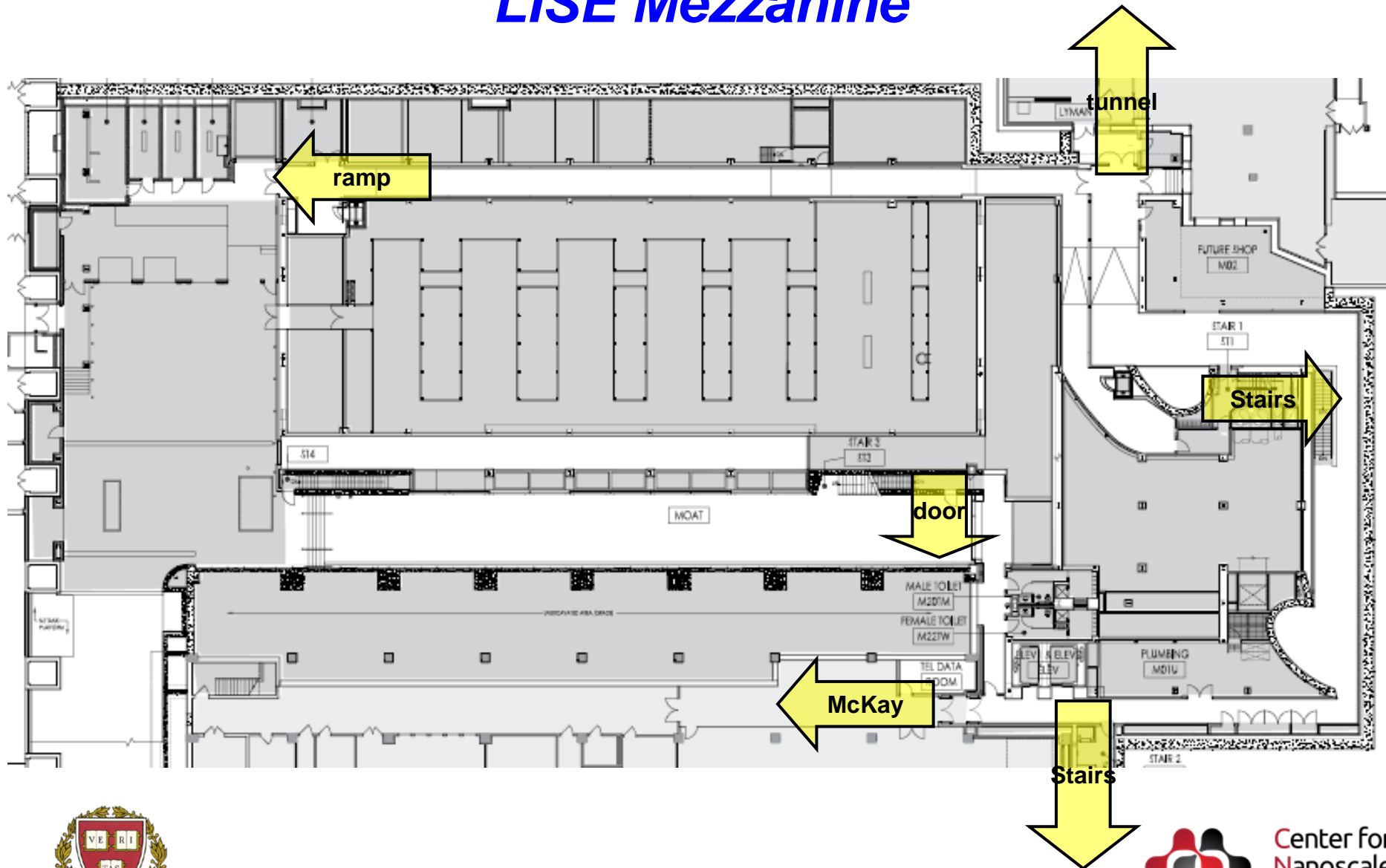
Emergency Evacuation LISE Basement



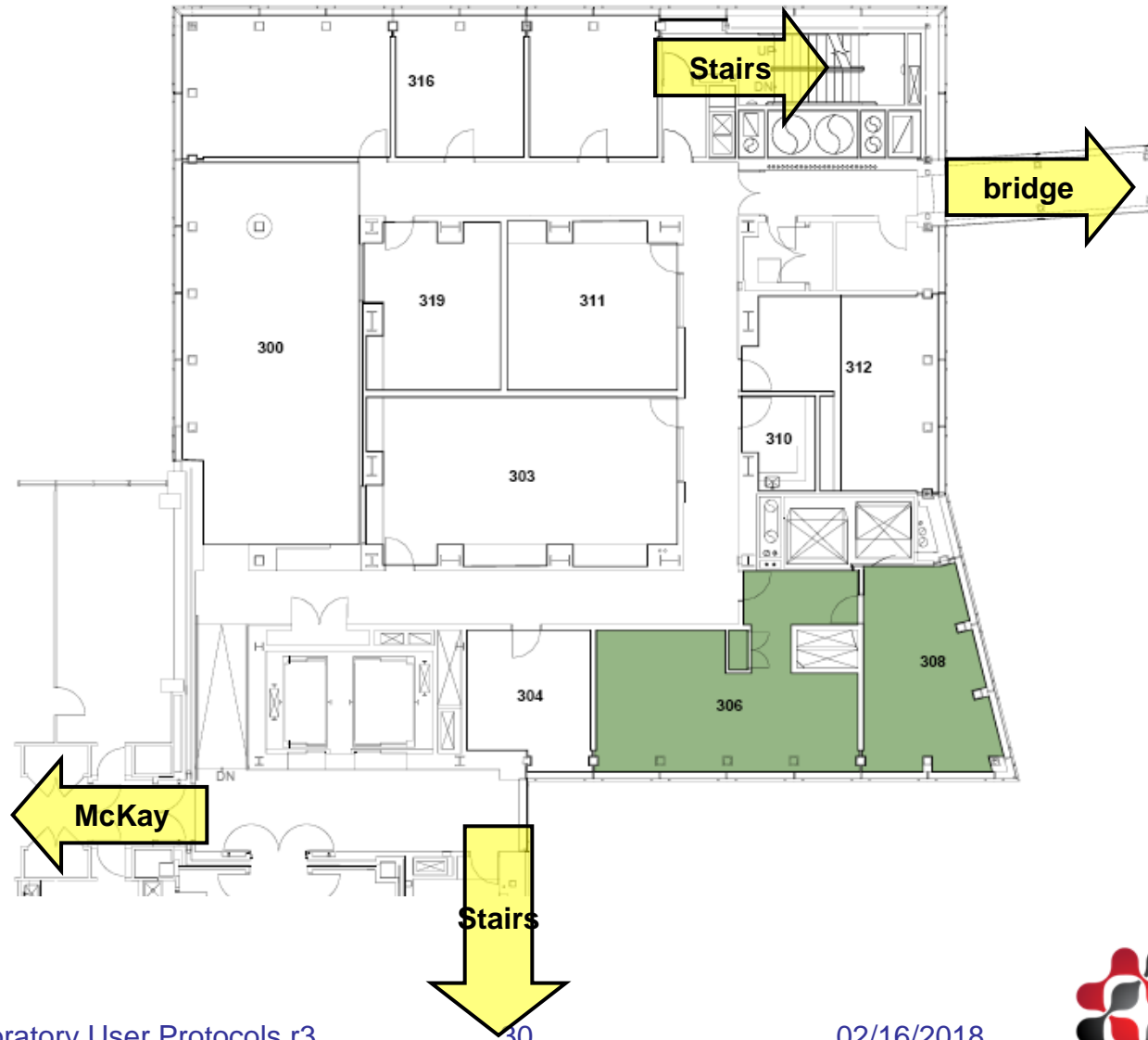
Emergency Evacuation LISE Ground Floor



Emergency Evacuation LISE Mezzanine

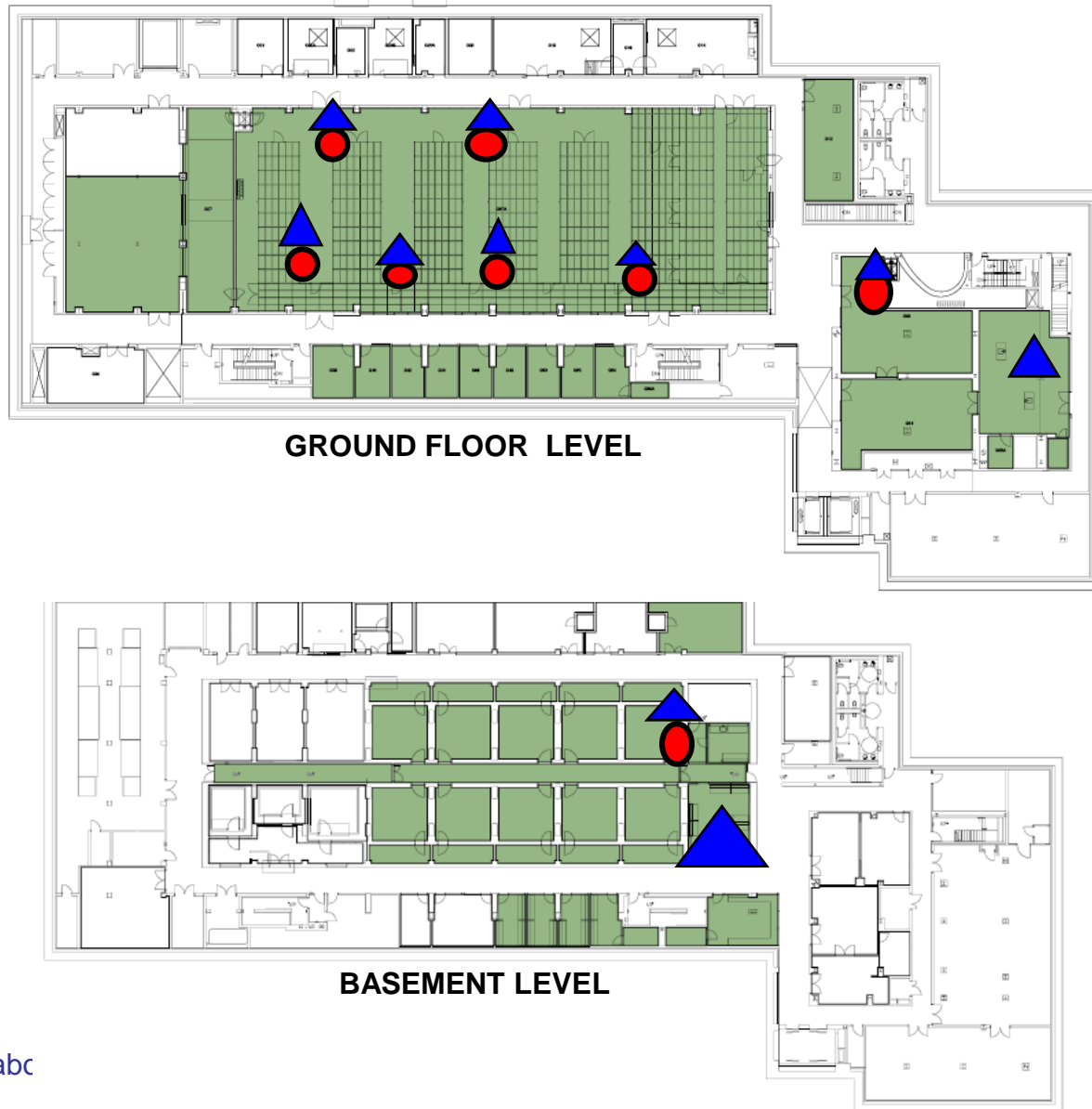
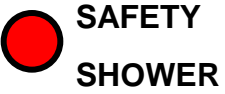


Emergency Evacuation LISE Third Floor (Offices)



Emergencies

Safety Showers and Eye Wash Stations



Labc



Center for
Nanoscale
Systems

Harvard University

Equipment Use Basic Policies

- All users must be trained and certified by CNS staff members before being allowed to schedule and use equipment.
- All tools (except some simple tools like OM) have an interlock (CLEAN) provided.
- Every user needs to log in and activate the tool, using CLEAN system in the common computer in the lab. Once finish your tool usage, fill up all required information in CLEAN and log out.
- In CLEAN, “Walk-up” is generally based on a “first-come-first-served,” basis.
- Scheduled equipment is on a “first-sign-up-first-served” basis. Users must cede equipment access to users with reserved time.
- It is every user’s responsibility to immediately report any unusual or unsafe occurrences to CNS or EHS staff, through CLEAN, email, or phone. Report in person or use Incident Report Form.
- It is every users’ responsibility to try their best to keep equipment in operating condition



Equipment Use

Basic Policies (continued)

- Read and adhere to all equipment hazard warning labels such as:
 - UV light Caution
 - RF and High voltage
 - Lock out Tag out signs posted on equipment
- Do not defeat any safety interlocks to gain access to equipment.



Equipment Use

New User Qualification Procedure

- **General Requirement to Access CNS Labs:**

(for detailed procedure, please go to the CNS website)

- Enroll into CNS User Program
- Read and understand this protocol
- Read the User Supplied Chemical Protocol
 - in <https://cns1.rc.fas.harvard.edu/user-info/>
- Complete LISE CNS Safety Training
- Take and pass the online CNS User Protocol (CUP) Quiz
- (for cleanroom users) Complete CNS Cleanroom Orientation
- Upon the completion of all the trainings, laboratory access will be issued to the new user.



Equipment Use Certification

- Only certified users are allowed to schedule and use equipment
- Official training will be conducted by assigned CNS staff; please check CNS website for names of staff-in-charge for each tool.
- Sign up the tool training through CNS website, or directly contact the staff-in-charge of the tool.
- Please read request and read SOP prior to training
- Final certification will be conducted by CNS staff
- Retraining may be necessary if a user hasn't used a specific tool for a long period of time



Contamination

Types and Sources

Types of Contamination

- Particulate: dust, makeup, skin, hair, ...
- Chemical: oil, grease, sodium, perfume, ...
- Biological: bacteria, fungi, ...
- Radiation (ultraviolet light, ...)

Sources of Contamination

- People (~ 75%)
- Ventilation (~ 15%)
- Room structure (~ 5%)
- Equipment (~ 5%)



Contamination Control Strategy – for all Labs

Personnel Control

- Dress code
- Laboratory Activity
 - messy activity
 - Contaminated gloves

Environmental Control

- Entrance/Exit control (room and equipment access)
- Supply, material and tool control (material request)
- Routine laboratory cleaning and maintenance



Contamination User Dress Code

- Wear appropriate garments, gloves, and safety glasses
- Not recommended: sleeveless shirts (short-sleeve shirt is acceptable)
- Not recommended: short pants and skirts (legs should be covered for safety and contamination control)
- Not recommended: slippers, sandals, open-toed footwear
- Not recommended: jewelries with sharp-points that can puncture through rubber gloves
- Not recommended: long finger nails (same reason as above)



Contamination

Contamination by Hand

- Special care required to avoid contamination being spread from gloves to other areas of laboratory
- Protective gloves must be used on chemical use area only, and must be cleaned or removed before handling any uncontaminated items
- Remove contaminated gloves before exiting wet benches and fume hoods
- Remove contaminated gloves before, touching phones, door knobs, keyboards, mouse, optical microscopes.
- Clean any general lab area that may have become contaminated before leaving
 - wipes are available for cleaning keyboards



Contamination

Donning Cleanroom Garments

Gowning Procedure (“Dressing Top-Down” and “Tucked In”)

- Start with gloves on both hands
- Hair covers
- Face masks over beard, mouth, nose
- Hood: cover the cap or hair
- Coverall (bunny suit): tuck the hood and mask inside the bunny suit
- Booties: tuck the coverall pant legs inside the booties
- Gloves: tuck the coverall sleeves inside the gloves
- Safety glasses or regular glasses with side shields



Contamination

Basics of Using Cleanroom Garments

- Garment should not be removed from cleanroom or gowning area
- Don't walk out of cleanroom with garments on except in the case of an emergency
- Always place garments back on the hangers. Don't place garments into the trash receptacle, or on the floor.
- If the garments was contaminated by small spills or some stains, put them into the plastic bags provided with clear label, and place back on the garment rack.
- Don't reach under your garment when in the cleanroom – return to gowning room if required to get phone, keys, etc



Contamination

Cleanroom Garment Reuse and Storage

- **Items can be reused within a week**
 - coverall (bunny suits): hang on the rack with the hanger assigned with your name
 - hood: stored inside the sleeves of your coverall
 - booties: hang with your coverall with snaps
 - your own safety glasses: stored in your tool box or inside the sleeves of your coverall
- **Items that should be discarded once used**
 - hair caps
 - gloves
 - face mask



Contamination

Handling Cleanroom Materials and Tools I

- **General Perspective**

- Don't bring non-cleanroom items into a cleanroom
- Don't take cleanroom items out of a cleanroom

- **Writing Paper, Notebooks and Pens**

- Only use cleanroom papers and notebooks inside a cleanroom
- Use ball point or nylon tipped pens; don't use pencils and crayons

- **Wipes**

- Don't cut wipes in a cleanroom



Contamination

Handling Cleanroom Materials and Tools II

Tools

- Prepare at least one tool box for storing your non-shared items
- Wafer processing tools, such as tweezers, scribes, timers, glassware, etc., should always stay inside your own tool box when not in use
- Always keep dedicated cleanroom tools inside the cleanrooms
- Don't bring non-cleaned tools into a cleanroom without cleaning and permission

Storage

- Store your tool box and other non-shared materials in the places assigned to you
- Don't take/use other users' non-shared items without their permission

