

**JOHN O'BRIEN NANOFABRICATION
FACILITY
POLICY AND SAFETY MANUAL**



USC University of
Southern California

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1 CLEANROOM ACCESS

- If you are interested in becoming a user of the cleanroom, please follow the below procedure.
- Take USC general Lab Safety Class. Instructions for signing up are on the [EHS Website](#).
- After completing the lab safety class, email the cleanroom Staff and make an appointment to meet. Before attending the meeting, please review the Cleanroom policy.
- Bring a copy of your lab safety training certificate to the meeting with Cleanroom staff. During this meeting, you will review the Cleanroom policy again, and you will be asked to complete [the new user form](#). Therefore, it is important that you understand the rules and ask any questions during this meeting. Any violations to these rules can result in your cleanroom access being suspended. This form also needs to be signed by your advisor.
- The staff will check whether you have finished your online General Lab Safety Exam during the approval process.
- Lab manager will give you a clean room orientation.
- Your campus ID card will be activated to access the facility

2 HOURS OF OPERATION

The cleanroom is open from 8 am to 6pm Monday to Friday. After hours and weekend hours are restricted to experienced users; these users are designated by the cleanroom manager.

3 ACCESS PROCEDURE

Users need to use their USC ID card to enter the cleanroom. Hold the ID card near the reader to the right of the door, wait a few moments, and the door will open automatically.

Users must swipe out with their ID cards before exiting the cleanroom.

The ID card reader also records cleanroom usage hours. Do not share your card. As per University policy, your ID card is not transferable. Do not bring any visitors to the cleanroom. All the users entering the cleanroom must be approved by the staff.

4 LIST OF MATERIALS NOT ALLOWED IN THE CLEANROOM

- Food or drinks
- Chewing gum
- Powders
- Paper (special cleanroom paper is provided in the cleanroom)
- Wood or any kind of fabrics
- Materials that will change to powder once the solutions or suspensions are dried
- Pencils, pens, erasers, or tape (cleanroom pens are stocked in the cleanroom)

- Cardboard
- Styrofoam products
- Do not rip paper inside the cleanroom

5 DRESS CODE FOR THE CLEANROOM

- Do not wear clothing that will "shed" lint or fibers
- No shorts, skirts, or open-toed footwear is allowed inside the gowning area or inside the cleanroom
- Long pants that cover your legs are required
- Shirts must cover the upper arm, lower back, and stomach
- Shoes need to fully cover your feet
- Do not wear flip-flops or sandals
- Sandals with socks are not appropriate attire
- Only flat or low-heeled shoes are permitted
- No makeup is allowed since it might generate particles. **Cosmetics** in the cleanroom are a source of particle contamination, please **avoid use** completely. Powder aerosols, hair sprays, and make-up are notorious particulate sources.

6 GOWNING PROCEDURE FOR THE CLEANROOM

- 1) Before you enter the cleanroom, use the shoe brush to remove dust/mud particles from your shoes. Use the **shoe cleaner** for at least **5 seconds per shoe**.
- 2) Enter the gowning area of the cleanroom using your USC ID card.
- 3) Step on the tacky mat and tap your feet 3 to 4 times per foot. This helps remove some of the dirt from your shoes.
- 4) Put on the blue shoe covers. This will cover your soles and sides of your shoes.
- 5) Put on a facemask.
- 6) Put on a bouffant cap. The bouffant cap should cover your head and ears. Try to tuck all your hair under the cap.
- 7) Put on gloves.
- 8) Put on a hood; it should go over the bouffant cap covering the head, ears, and neck. It will touch your shoulders.
- 9) Put on the coveralls. The hood should go inside the coveralls. Tuck the cuffs or sleeves of your gown inside the gloves. The gloves you are wearing will fit to your wrist. Securing your gown under the gloves will make sure that your wrist is fully covered by the gown and the gloves.
- 10) Put on boots. Use the adjustment snap connector to secure the boots.
- 11) Put on your safety eyewear. Safety eyewear must be worn in the cleanroom. If you are wearing prescription glass, then put your safety eyewear on top your prescription glasses. Prescription-fitted glass safety eyewear is available at the USC Roski Eye Institute.
- 12) Put on the second pair of gloves.
- 13) Check your gowning fit in the mirror.
- 14) Enter the cleanroom by waving your hand door sensor switch.

7 EXITING THE CLEANROOM

- 1) Enter the gowning area

- 2) Remove the safety eyewear.
- 3) Remove boots. If they are dirty or worn out, throw them in the trash, otherwise put them in the bin labeled “used boots.”
- 4) Remove outer gloves. You should be wearing two sets gloves when you enter the cleanroom.
- 5) Remove coveralls and hang on the hangers. If the gown is dirty or worn, throw it out and replace it. Make sure that you are not touching the coveralls with your bare hands.
- 6) Remove hood and hang it with the coveralls.
- 7) Remove the bouffant cap and the facemask. These should only be used once and then thrown away.

8 GENERAL BEHAVIOR IN THE CLEANROOM

- When in doubt, ask the cleanroom Staff.
- Do not unzip or remove your gowns inside the cleanroom.
- Do not use your cell phone or headset in the cleanroom.
- Do not run in the cleanroom.
- Clean up the process bench after you are done with your experiment.
- Do not leave the wipes on the process bench or on the equipment.
- Make sure that you turn off the hot plate after you are done.
- If you see any materials on the floor please throw them in the trash.
- Clean the spinner after you are done with your process. If any photoresists spill on the process bench or on the floor clean it immediately.
- Do not leave chemicals unattended for more than 15 min. If you are leaving the chemicals for more than 15 min, make sure you label it appropriately (see the protocol in Section 12 Chemical Usage).
- Clean your glassware after you are done with your process.
- Coughing and sneezing while in the cleanroom is not desirable. Don't work in the cleanroom when you have a cold or flu.
- Do not remove your cleanroom garments in the cleanroom unless it is to use the emergency shower.
- Protective eyewear must be worn at all times while in the facility. Protective eye wear is provided for you at the entrance to the cleanroom if you don't have a need for prescription eye wear. Be sure to return the protective eyewear back to the smock room. Wearing of **contact lenses** while in the cleanroom is forbidden due to safety problems. If an individual feels that they must wear contact lenses while in the cleanroom, they will need to speak with the lab manager for alternative arrangements.
- **Do not open the doors facing hallway in clean room & chase at any time, unless in emergency situation.** Open doors cause lost room pressurization; alarms are set off; and particle counts in the cleanroom will rise.
- Absolutely **no horseplay** in the cleanroom.
- **Do not conduct any unauthorized process or operations in the cleanroom.**
- The lab staff must approve all materials used in processes in the Cleanroom. If the slightest question exists on whether a process is currently allowed, check with the lab staff. These rules are not intended to be restrictive for research, but rather to provide a safe facility that allows a wide base of researchers to work in a common facility with minimal difficulty.
- Clean up after yourself. Do not expect someone else to pick up after you in the

cleanroom. Keep your area neat and properly dispose any trash or waste chemicals you generate. Put borrowed tools away. Place chairs back under benches. Leave the area in better shape than when you arrived. Practice good housekeeping, it is safer and makes the cleanroom look better for VIP's visits.

- Any issue involving safety, unsafe working practices, or an unsafe working environment, must be brought to the immediate attention of the lab manager, the Director of CPT, or the Cleanroom Faculty Group.
- Do NOT borrow other user's equipment or material without their permission. Do not use other people's or group's glassware, metal source materials, tools, chemicals, etc.....

9 EQUIPMENT

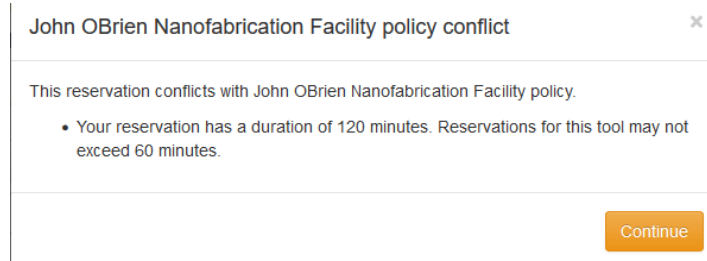
- **You must always log in the log book of any tool that uses a log book! Read** the past entries from the last few days in order to make sure you are aware of any problems or "strange" things that happened. This could prevent you from ruining your experiment. Record your operating parameters and what you are doing. Record any problems or "strange" things you saw and notify the lab manager.
- Do not attempt to train yourself or to run a piece of equipment that you have not been checked out on. If you have been trained and are capable of running the system, do not run the machine outside of commonly accepted parameters without first checking with the lab manager.
- If a tool has been "**locked down**" or "**tagged out**" for a safety or operational problem, it is not to be run until those issues are properly resolved. For any questions about a "down" tool, see the lab manager.
- **Be aware** that systems that generate high voltage need to be powered off and have the caps discharged with a grounding rod before being worked on. These high voltages developed and stored can be lethal.
- Don't defeat system interlocks unless you are performing maintenance or repairs on a system. If you do have to defeat an interlock, you must inform lab manager, be working in a team or buddy system.
- Don't log onto pieces of equipment when not actively using them. If you make reservation for equipment and can't make it, please cancel the reservation 24 hours before. If possible, email to the group so that other users can take over.
- Don't over book equipment.

9.1 EQUIPMENT FAILURES

Equipment breakage, malfunction, etc., has to be reported to the Cleanroom Staff and log the problem in the logbook. Users should not try to fix anything themselves. Because the equipment is expensive and parts might be difficult to replace, any damage will lead to high costs and downtime due to careless attempts to fix the equipment. These unauthorized attempts might result in suspension and the user will be responsible for repair costs.

10 TOOL RESERVATION POLICY

- 1) You must be qualified to reserve the tool on the NEMO Calendar
- 2) Tools can be reserved on a first-come-first-served basis and can be booked seven days in advance
- 3) Each tools have certain rules for duration that you can reserve, if there is conflict there will be message displaying reservation conflict.

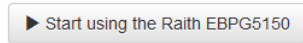


- 4) Enable the tool in Nemo before you use it and disable it after you finish using it.


 **This tool is operational and idle.**

Tool usage: **\$50.00**
 Tool individual training: **\$40.00**
 Tool group training: **\$40.00**
 Tool missed reservation: **\$50.00**

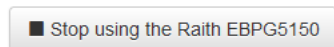
Tool usage will be ... lia".



To Enable the tool – select the tool and click “ Start...” button

 **You are using this tool for the project named Cleanroom Training since Monday @ 12:44 PM.**

Tool usage: **\$50.00**
 Tool individual training: **\$40.00**
 Tool group training: **\$40.00**
 Tool missed reservation: **\$50.00**



To Disable the tool – select the tool and click “ Stop....” Button

- a. If you have not logged in within 15min of the scheduled start time, your reservation will be cancelled in Nemo.*
- b. See “missing reservation” and “billing” policies for more information.

5) Missing Reservation Policy

- a. To avoid “no-show” charge, cancel your reservation at least 24 hours in advance and let the user community know that slots are available.

Raith EBP5150 reservation details

Title: Shivakumar Bhaskaran (shiva) Set title

User: Shivakumar Bhaskaran (shiva)

Created on: Monday, November 22nd, 2021 @ 12:47 PM

Tool: Raith EBP5150

Start: Wednesday, November 24th, 2021 @ 10:00 AM

End: Wednesday, November 24th, 2021 @ 1:00 PM

Identifier: 1140

Cancel this reservation

- b. Users will be emailed 15min after they missed the reservation and it's cancelled in the calendar.

MISSED RESERVATION NOTIFICATION

ai,

You missed your reservation to use the KJL Sputter in the facility starting at Monday, October 25th, 2021 @ 10:00 AM and ending at Monday, October 25th, 2021 @ 12:00 PM.

The tool was not used for more than 15 minutes after the start of your reservation, therefore your reservation time has been marked as 'missed' in NEMO and cancelled on the calendar.



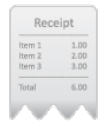
Please remember that the facility is a shared resource, and missing a reservation may inhibit the productivity of other facility users.

- c. First offense: After five missed reservations (or going over reservations) within a 6 month timeframe, a user's privileges will be suspended for 1 week, and the PI will be notified. Second offense: After an additional five missed reservations (or going over reservations) within a 6 month timeframe, a user's privileges will be suspended for 1 month, and the PI will be notified.

6) Billing Policy

- a. To avoid “no-show” charge, cancel your reservation at least 24 hours in advance and let the user community know that slots are available.
- b. If you have not logged in within 15min of the scheduled start time, you will be billed for 50% of reserved time.*

*If the tool is actively in-use (a prior process went over) or other approved emergency, this rule can be waived.

Usage Fees	https://nanofab.usc.edu/tools-and-capabilities/user-fees/
Tool Scheduler	https://nemo-usc.usc.edu
To view the cleanroom activities	https://nemo-usc.usc.edu/jumbotron/
To Reserve the tool in calendar	
To Enable/Disable the tool	
To view usage (Billing/hours)	

11 BUDDY SYSTEM

No users are allowed to use the cleanroom alone. At any given time, at least two users must be present.

12 CHEMICALS AND HAZARDOUS MATERIALS

12.1 Classes of Chemical Hazards

A. Corrosive

Corrosive materials can cause burns and destruction of living tissue by chemical action. On contact, corrosive can affect skin, underlying tissues, eyes and respiratory tract. Most Corrosive chemicals are acids include hydrochloric acid, hydrofluoric acid, sulfuric acid, nitric acid, acetic acids. Common bases are ammonium hydroxide, sodium hydroxide, potassium hydroxide.

Refer to [Standard Operating Procedure](#) for Corrosive materials.

B. Water Reactive

Water reactive materials on reaction with water will produce heat and gas. Concentrated Sulfuric acid and piranha are water reactive.

Refer to [Standard Operating Procedure](#) for Water Reactive materials.

C. Flammable and combustible liquids

Flammable and combustible liquids are grouped or classified based on their flash point, with flammable liquids will ignite and catch fire at normal working temperature having a flash point below

100°F (37.8°C) and combustible liquids having a flash point at or above 100°F (37.8°C) and below 200°F (93.3°C)

Refer to [Standard Operating Procedure](#) for working with Flammable materials.

D. Oxidizer

Oxidizer are reducing agent that can initiate combustion when mixed with other compounds and release oxygen that result in violent reaction and possibly cause explosion

Ex Hydrogen peroxide, Nitric acid

Refer to [Standard Operating Procedure](#) for working with Oxidizer materials.

E. Toxic/Poison

Toxic materials are substances that has serious harmful effect and poisonous.

Refer to [Standard Operating Procedure](#) for working with Toxic materials.

12.2 Chemical Liquid Hazards

A. Acetone and other solvents

Acetone is flammable solvent with low flash point. Any flammable solvents should not be heated in Obrien Nanofabrication Facility and do not leave next to the hotplates. Acetone spill may cause fire and may easily drawn into the exhaust ducts and might cause catastrophic effects. Any spill must be contained immediately.

B. HF

Hydrogen fluoride is a highly corrosive chemical that can cause severe and deep burns on exposure. It is imperative that medical assistance be provided for any exposure to HF and the treatment be initiated promptly. Hydrogen fluoride differs from other corrosive chemicals in that the fluoride ion readily penetrates the skin causing destruction of deep tissue layers including bone. However, its critical harmful effect comes from the action of the fluoride (F-), not acid burn. Fluoride ion from HF forms such a strong bond to Ca²⁺ in bones. It reaches to bones and leaches calcium from bones and may tie up calcium in nerve cell. This disruption of nerve condition can be life threatening when disrupting a heart function.

Refer to [Standard Operating Procedure](#) for working with Hydrofluoric acid and [HF Exposure Treatment](#).

C. Piranha and Nanostrip

Piranha solution is mixture of concentrated sulfuric acid and 30% hydrogen peroxide. This mixture is extremely aggressive oxidizer, used to remove photoresists, contaminants like metal and most commonly used for wafer cleaning. Do not dispose the piranha waste immediately, as the waste continues to react and needs more time to decompose until it cools off. Disposing of hot piranha might cause to build up pressure and cause to burst. Instead of piranha, use Nanostrip, a commercially available stabilized piranha

D. Hydrogen Peroxide

Hydrogen Peroxide is strong oxidizer can cause fire when mixed with incompatible materials. High concentrations of hydrogen peroxide (>30%) must handled carefully and need approval from cleanroom staff.

E. Chlorinated Solvents

Chlorinated solvents (chlorobenzene, trichloroethylene) has detrimental effect on human body causing organ damage or cancer. Do not mix with normal waste solvents.

12.3 Gas Hazards

A. Silane

Silane is a silicon precursor for many silicon-containing films. It is colorless, poisonous gas, and flammable with a strong repulsive odor. Silane is lighter than air and forms white fumes at leakage

B. Chlorine

Chlorine is yellow-green gas heavier than air at room temperature and has pungent odor. Chlorine is toxic when inhaled

C. Ammonia

Ammonia is corrosive colorless alkaline vapor with a pungent odor. Upon inhalations can cause upper/lower airway irritation and interstitial lung and eye irritation

D. Boron trichloride

Boron trichloride is colorless gas with pungent odor, decomposes in water to hydrogen chloride and boric acid. Highly corrosive to metals and tissue and is toxic. Forms white fumes in humid air

E. Silicon tetrachloride

Silicon tetrachloride is colorless, fuming liquid with a pungent smell. It is corrosive to metals and tissue in the presence of moisture.

F. Nitrous Oxide

Nitrous oxide is colorless, sweet-tasting gas also know as “laughing gas” and inhalation of gas impair decision making process and used as an anesthetic. Vapors are heavier than air and is soluble in water

12.4 Other Hazards

A. Electrical

Electrical hazard are present wherever electricity is used. Most of the equipment is interlocked to prevent operator exposure, but everyone in the facility must be aware of electrical hazards from the tool. Electrical shock occurs when any part of body comes in contact with any electrical source and electrical energy flows through the body forms a complete circuit an may result in burn and high amount of electrical current may be lethal and kill a person.

B. Ultraviolet Radiation

Highly energized radiation are generation from plasma etch, plasma deposition and sputter tools, these energized species are well contained in the chamber, but there are possible UV exposure. UV lamps are used in Mask Aligner in photolithography, uses mercury-based and pose chemical and radiation risk due to lamp explosion.

C. Cryogenic

A Cryogenic Liquid is a liquid that has a boiling point at or below -150 0C (123 K).

Frostbite is damage to the skin and underlying tissues caused by extreme cold. Frozen tissue is painless and appears waxy with a pallid yellowish color.

Refer to [Standard Operating Procedure](#) for using Cryogenic Liquids

D. Electromagnetic Radiation

Plasma etch and Plasma deposition uses RF which may generate Electromagnetic Radiation. All the equipment is shielded to prevent any exposure.

12.5. GENERAL RULES FOR CHEMICAL USAGE

- Any “new” chemicals brought into the lab, must first be approved by the staff. A Material Safety Data Sheet (MSDS) must be supplied by the user. The MSDS is on the [EH&S Website](#)
- **CHEMICALS MAY NOT BE LEFT UNATTENDED FOR MORE THAN 15 MINUTES.**
If your process requires chemicals to be left unattended for longer than 15 minutes:
 - Notify staff to get permission.
 - You must add expected date and time of disposal on the label.
 - Labels must be legible.
 - The maximum time for unattended chemicals is 1 hour and this is subject to approval.
- Dispose sharps (glass slides, razor blades, etc.) in the proper Sharps containers (**NO** chemicals or photoresist contaminated items may be disposed in the Sharps containers).
- **Empty bottles** must be **triple rinsed** and thrown away in the regular trashcan.

12.6 LABELING REQUIREMENTS

All chemicals, glassware, etc., must always be labeled and include:

- User name
- Group (PI) name
- Contact information (email or phone number)
- Chemical name (use the chemical formula, not a common name)
- Label ALL chemicals, even water (a clear liquid is often NOT water)
- A labeler and markers are provided in the cleanroom to ensure that your containers can be labeled and relabeled when the markings wear off. You are responsible for determining when relabeling is necessary.
- Very small containers that cannot be labeled must be kept in another larger, labeled container.
- All containers not properly labeled will be disposed of. Any users caught violating this rule may be suspended from the cleanroom.
- Any person found working with an unlabeled substance in the facility will be cited.

12.7 GENERAL CHEMICAL WASTE DISPOSAL GUIDELINES

Dispose of chemicals in appropriate waste bottles. **Most of these are stored in the chemical cabinets in the common chase and under the wetbenches.**

- **Photoresist (PR)** waste with wipes should go into a separate waste container located on the floor next to the spinner. Do not throw out photoresist-contaminated wipes in the regular trash.
- **Developer waste** (generally Alkaline)
- PR wastebaskets, liquid PR waste containers, and PR-contaminated Sharps waste containers are located in the lithography area of the cleanroom.
 - **DO NOT** overfill trash containers.

- Follow the Chemical SOPs for waste disposal.

If you will generate any waste not identified above, you must first contact the staff for a new waste bottle. It will be labeled with the chemical composition and the date waste generation starts.

- Rinse empty chemical containers out three times
- Mark rinsed containers with a 3X and place on chemical waste cabinet
- All waste containers must have a 'CHEMICAL/HAZARDOUS WASTE FOR DISPOSAL' label filled out at their origin
- Chemical waste must be stored in the proper container

- Static electricity can easily cause 10KV discharges. When transferring solvents, Be very careful. Handling flammable solvents in the cleanroom must be done carefully.

12.8 SUPPLIED CHEMICALS AND CONSUMABLES

Chemicals (SOLVENTS):

- Acetone
- Isopropyl Alcohol or 2-Propanol (IPA)

Consumables:

- Wipes
- Pipettes
- Aluminum foil for the spinner
- Cleanroom paper for notes
- Sticky notes for labeling the beakers that are used in the process bench.

12.9 Hazardous Gases

Storage:

All toxic and hazardous gases are located in HPM (112) in first floor

- Gas cylinders are used as process gas for different equipment located inside the cleanroom.
- The gas cylinders are installed on the north side of the cleanroom – Room ?? – chase area.

HAZARDS – The materials and equipment associated with this procedure present the following exposure or physical health hazards. Safety precautions are prudent and mandatory.

- Release of compressed gas
- Gas leak
- Dizziness
- Poisoning
- Asphyxiation
- Fire
- Explosion

- Potentially serious personal injury potentially serious in the case of a catastrophic release of compressed gas pressure

Possibility of gas leak: This can be checked by periodic inspection of the cylinders, gas line, and fittings, as well as by periodically monitoring the gas level. The gas cylinder must be moved around with a cart that has a strap. All the gas cylinders are properly secured to the wall brackets or a fixed surface with a chain or straps. The valves are closed for gas cylinders that are not being used or empty cylinders. The regulator protector cap is secured if the cylinder is empty or not connected to the gas lines.

ENGINEERING CONTROLS – Prior to performing this procedure, the following safety equipment must be accessible and ready for use

- Use proper hand tools for working with gas regulators or when modifying gas lines.
- Proper gas cylinder transport dolly should be used to move cylinders even a short distance.
- Gas cylinder valve covers must be installed if moving cylinders.

PROTECTIVE EQUIPMENT – Prior to performing this procedure, the following personal protective equipment must be obtained and ready for use,

- Safety glasses
- Closed shoes
- Work gloves are optional but recommended if handling and/or moving large cylinders

WASTE DISPOSAL – This procedure will result in the following regulated waste, which must be disposed of in compliance with environmental regulations.

- Empty cylinders

ACCIDENTAL SPILL – In the event that hazardous material spills during this procedure, be prepared to execute the following emergency procedure.

- See the procedure on gas leaks in Section 5 - Emergency Procedures.

Room	Gases of Concern	Contact	Office	Email
LL103N	SF6, CF4, He, C4F8, CHF3, Ar	Shiva Bhaskaran Donghai Zhu	213-821-2374 213-740-1065	sb86922@usc.edu donghaiz@usc.edu

12.10 Hazardous Gas Sensors

Honeywell “Midas” gas detectors of four? types are used, namely *Hydrogen (Hydrogen, Methane) hydride* (, silane) *Amine(ammonia)*, and *Halogen (Chlorine) Mineral Acid (Boron Trichloride, Silicon Tetrachloride)*. Detectors of the appropriate type(s) are situated as follows:

- On the exhaust outlet of each Gas Pod connected to the equipment in the Chase.
- On the exhaust outlet of each valve/manifold cabinet.

- On the exhaust outlet of the hazardous gas scrubber system which services the vacuum pumps. (check this)?

Other Sensors

There are further sensors to detect the following:

- Fire (UV/IR) and smoke.
- Spill Sensor (for liquid spills)
- Loss of exhaust to the vacuum pumps.
- Corrosive Exhaust Flow Sensor
- Solvent Exhaust Flow Sensor
- Manual Pull Station

11.10.1 GENERAL PROCEDURE FOR GAS HANDLING

This general procedure is only a guideline. The handling of cylinders may be considered routine, but it is far from a trivial procedure. This procedure should not be considered a replacement for proper training. Only trained personnel should handle gas cylinders.

The hazards are varied and depend upon cylinder size, pressure, quantity, and nature of the gas. Hazards range from small leaks and dizziness to poisoning, asphyxiation, or serious bodily injury, especially when handling large, heavy cylinders. This is not an all-inclusive list.

- In general, there should be no storage of flammable gases in this room; it lacks the proper equipment for such storage.
- No toxic gases may be stored in this room. It lacks the proper equipment.
- Gas cylinders being moved should be done only if their cylinder valves are closed—even when moving them a short of distance. This is a basic, necessary precaution; do not disregard it.
- Gas cylinders being moved should be done only if their valves are secured with the proper valve cover for transport. When moving larger cylinders the proper gas cart or dolly must be used, even when moving these a short distance. These cylinders are very heavy and present substantial hazards—whether they are full or empty.
- Gas cylinders must be secured with the proper cylinder tethers. Do not leave a cylinder standing on its own—this is extremely dangerous.
- Do not store empty or unwanted cylinders in this lab.
- Please visit the EH&S website regarding compressed gas cylinders.(website link)

13 EMERGENCY RESPONSE PROCEDURES

13.1 EMERGENCY PHONES

The emergency phone is located in the Cleanroom (see the cleanroom layout).

13.2 CHEMICAL SPILL

Photoresist spills should be cleaned immediately with acetone; otherwise, the liquid spill becomes hard and solid. This might be difficult to remove from the process bench or the floor.

A developer or solvent spill can be removed using wipes or absorbent material (located on the wire rack). Soak up the spill for a few minutes and then put the contaminated waste in a separate trash bag.

13.3 EMERGENCY EYEWASH

The eyewash is located in the Base and Acid wetbenches. If any chemicals get into your eye, wash your eye for 15 minutes and seek medical attention immediately.

13.4 FIRST AID KIT

The first aid kit is located in the gowning area and on the wire racks next to wetbenches.

13.5 SAFETY SHOWER

Any chemical exposure to any part of your body should be handled immediately by using the safety shower (see the layout for location of the safety shower). Remove all of your gowns and clothing and expose the contaminated area of your body to the safety shower. Try to remove the chemicals from your body as soon as possible. Rinse the affected area for 15 minutes. When spills like this occur, get help from other users and ask them to use the emergency phones to contact the campus police and also report the incident to EH&S. Seek medical attention immediately.

All chemical spills or accidents should be reported to EH&S and to the lab staff.

For any major chemical spill—for example, if there is more than a gallon of liquid or you were not able to get it clean on your own—you need to get assistance. Please stop trying to clean the spill and contact the lab manager or EH&S.

13.6 EMERGENCY PROCEDURES

- **Small chemical spills:** These can be cleaned with a spill kit or simple items like wipes or absorbent pads. The spill kit is located on the wire shelf in the lithography bay of the cleanroom (see map).
- **Large or “complex” spills:** Evacuate the room and call EH&S or DPS from the cleanroom.
- **Eye contact:** Immediately rinse eyes at the eyewash station. Hold eye open for 15 min. Seek medical attention immediately.
- **Ingestion:** Obtain medical attention immediately.
- **Inhalation:** Obtain medical attention immediately if symptoms develop (coughing, shortness of breath, wheezing, burning in mouth or throat, or chest pain).

- **Fire or explosion:** Activate the fire alarm using the nearest pull station. Evacuate the building and call DPS. Meet emergency responders outside.
- **Water leak:** If you can handle the situation safely, watch for electrical hazards and get necessary help. If the situation leads to a flood, immediately call for help.
- **Gas leak:** Shut off the gas if it is safe to do so. If there is an uncontrolled release of flammable or toxic gas, evacuate immediately and close the door behind you. Initiate building evacuation by activating the fire alarm using the nearest pull station. Call DPS from a safe location. Meet emergency responders outside. If you have been exposed, call someone to assist you or remain with you in case you lose consciousness. Seek medical attention immediately.
- **Mercury lamp explosion:** Mercury vapors are toxic. Evacuate the cleanroom immediately. Report the incident to the Lab Manager. Follow the procedure for proper usage of the mask aligner explained in the SOP.

13.7 EMERGENCY RESPONSE

Gas Leak, Toxic spills	<ul style="list-style-type: none"> • Pull the Blue Pull station • Evacuate the building and meet at Emergency Assembly point
Emergency Eyewash	<ul style="list-style-type: none"> • The eyewash is located in the Base and Acid wetbenches. • If any chemicals get into your eye, wash your eye for 15 minutes and seek medical attention immediately. • Report incident to DPS & EH&S • Seek medical attention immediately • Escort the user to the Medical Facility
Safety Shower	<ul style="list-style-type: none"> • Any chemical exposure to any part of your body should be handled immediately by using the safety shower • Any chemical exposure to any part of your body should be handled immediately by using the safety shower • When spills like this occur, get help from other users and ask them to use the emergency phones to contact the DPS and also report the incident to EH&S. • Seek medical attention immediately.
Life-Threatening Emergency	<ul style="list-style-type: none"> • Press the Panic Button (If you are wearing one) • Go to the Emergency phone and speak loudly about your situation • Call 911 immediately
Building and Facility Equipment Emergency	<ul style="list-style-type: none"> • Call Cleanroom Staff Immediately • After Hours call DPS/FMS • Which equipment? How to respond?
Power outage	<ul style="list-style-type: none"> • Emergency lights should be on in 5-10 sec • Stop the process and evacuate the building safely (use the staircase)
Chemical Spill	<ul style="list-style-type: none"> • Small spill – follow the procedure as described in the training (use proper protective equipment) • Large Spill – if you are not comfortable in containing the spill, then call the Cleanroom staff. After hours call EH&S • Please review Chemical SOP and EH&S for spills https://ehs.usc.edu/hazmat/spill-cleanup/
Odor in the lab	<ul style="list-style-type: none"> • Leave the area immediately and warn other users in the cleanroom • Notify Staff • After hours call EH&S
Earthquake	<ul style="list-style-type: none"> • Take cover and wait for the shaking to stop. • Stop the process, Press Emergency Button the tool that you are using. • Dispose or contain the chemical safely or secure it in secondary containment • Use the staircase to evacuate the building and meet at Emergency Assembly Point

For any Non-Life-Threatening injury, please follow instructions at, <https://ehs.usc.edu/occhealth/non-life-threatening-workplace-injury-or-illness/>
Engemann Student health center at USC campus is located at 1031 W 34th St, Los Angeles, CA 90089

13.8 BUILDING ALARMS

If the siren or strobe light is activated, users should evacuate the facility immediately (see the exits signs on the layout). After you reach the designated safe area, you can remove your gowns and throw them out.

13.8.1 Fire Alarm:

Fire alarm system is a fire protection system that is composed of

- Alarm initiating units which are smoke detectors, heat sensors
- Alarm notification system – that produce loud noise such as sirens, strobe/horns
- Fire Control units which are sprinkler, fire extinguisher

The fire alarm system can be triggered automatically when smoke detectors or sensors detect certain level of heat or smoke which will cause the strobe to flash and very loud pulsing sound.

In the event of Fire Alarm activation, users should evacuate the facility immediately (see the exits signs on the layout). After you reach the designated safe area, you can remove your gowns and throw them out.

Fire Alarm strobes located in the throughout the basement (including cleanroom) and in the Mi2chelson Convergent Bioscience (MCB) and adjacent Ray Irani building. The strobe is a rectangular, clear light mounted on a bright red frame.

13.8.2 Toxic Gas Alarm:

Toxic gas alarm is located in the cleanroom and throughout the basement. The strobe blue color and rectangular shaped. There are two levels of alarm

Level1 – Low Alarm, this is due to gas leak from the enclosed area like gas pod, equipment and Valve Manifold Box (VMBs). All cleanroom users have to be evacuated and reach the designated safe area.

Level2- High Alarm, this is due to toxic gas leak might not be enclosed area. This will activate the white strobes as well as blue strobes, which all the building occupant has to be evacuated and reach the designated safe area

TGMS do monitor heat sensor, exhaust flow, air conditioner, to ensure safety of occupants in the lab and the building.

13.8.3 Oxygen depletion alarm:

Oxygen depletion alarm located in the enclosed area where nitrogen is used, especially when Liquid Nitrogen is used to fill the dewar and also Nitrogen gas is used to fill the Ultra-pure tank in RO/DI water room (LL193). O2 depletion sensor is located throughout the basement where N2 is used.

This O2 depletion alarm is tied up to TGM system, any alarm the all the basement occupant is evacuated.

13.9 CLEANROOM ALARM RESPONSE MATRIX

	MCB Building Occupant	Cleanroom & HPM Users
Toxic Gas Low Alarm	No	Evacuate
Toxic Gas High Alarm	Evacuate	Evacuate
Building Fire Alarm Activation	Evacuate	Evacuate
UV/IR Fire Detector (Wet Benches, VMBs, Gas Cabinet at HPM))	Evacuate	Evacuate
Early Warning Smoke Detection (Alert, Action)	No	No *
Early Warning Smoke Detection (Fire1, Fire2)	Evacuate	Evacuate
Fire/Smoke Detected HPM and Basement	Evacuate	Evacuate
Haz Mat Manual Station (Blue)	No	Evacuate
Oxygen Alarm (Low Level)	No	Evacuate (Local area, Room)
Oxygen Alarm (High Level)	No	Evacuate
Loss of Exhaust	No	Evacuate
Solvent Bench Suppression System (Wet Bench)	Evacuate	Evacuate
Seismic Event		Turn off the equipment, secure the Chemicals (see Sec 3. Emergency Response)

14 SUSPENSION POLICY

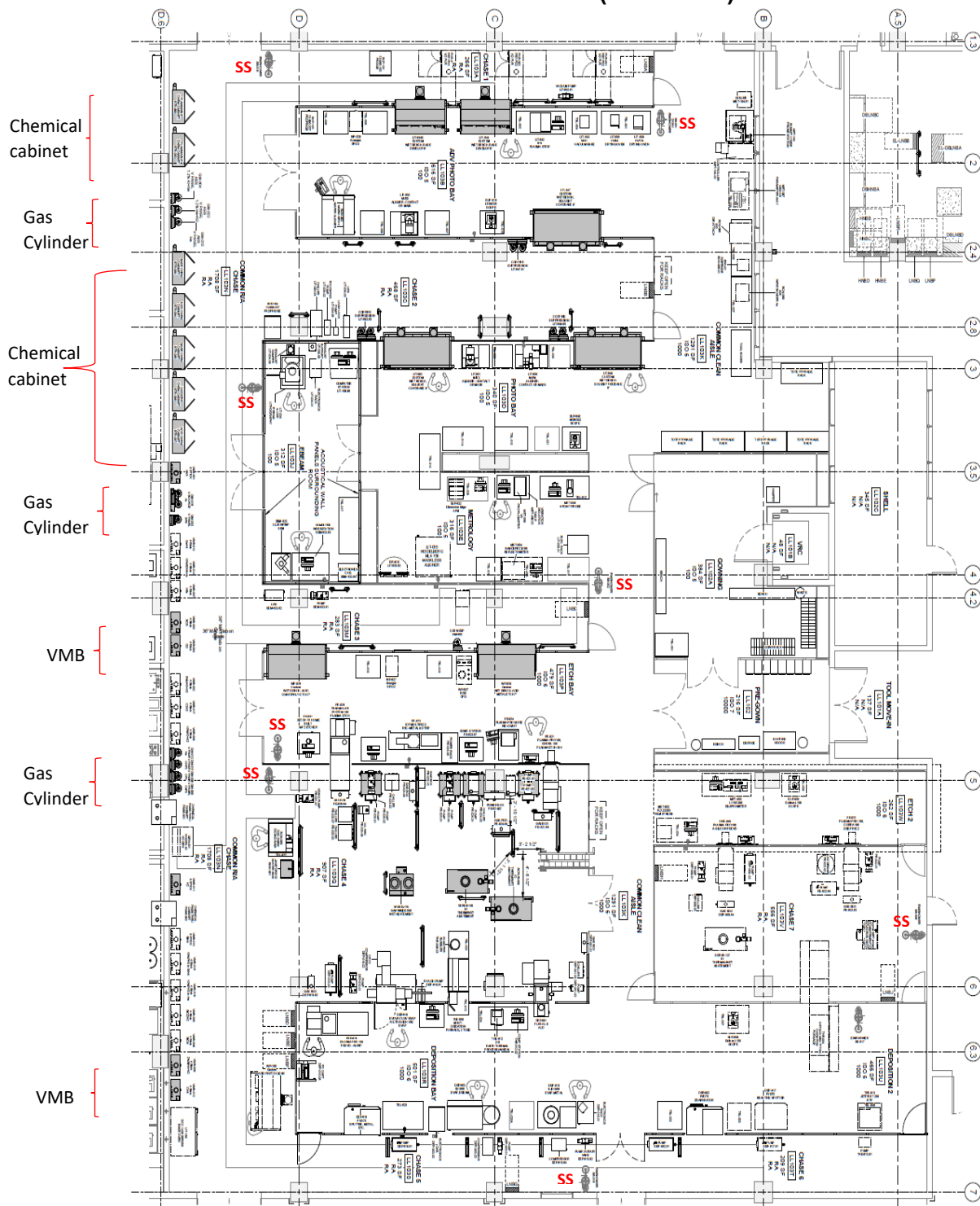
Users will be suspended if they do not follow the rules. The suspension time will range from one day to a number of weeks, based on the severity of the inappropriate action. Over three suspensions will cause the termination of a user's access to the cleanroom.

- Do not train users. Only authorized users with the permission of staff are allowed to train users.
- Entering the cleanroom with someone else's ID card is not allowed.
- A user is not allowed to use a time slot that has been reserved by another user.

- A user is not allowed to use equipment that is not working or under maintenance.
- Do not leave chemicals unattended.
- Do not steal or use someone else's materials without the user's permission.
- Do not remove supplies or equipment from the cleanroom.
- You must wear proper personal protective equipment (PPE).
- Do not enter the cleanroom if you are unauthorized to do so and do not follow another user in. All users must swipe in and out themselves.
- Do not cause damage to the equipment.
- You must follow proper gowning procedure.
- Do not wear shorts/skirts/open-toed shoes.
- You must clean the spinner after you are done using it.
- You must clean your workspace and the process bench after you have completed your work.
- Do not bring chemicals into the cleanroom without staff approval.

The policies and procedures described above are to ensure a safe work environment for researchers. They allow a user to work productively while maintaining the cleanroom environment and equipment. The policies and procedures will change over time based on the future needs of the cleanroom's operation.

MAP OF CLEANROOM (BASEMENT)

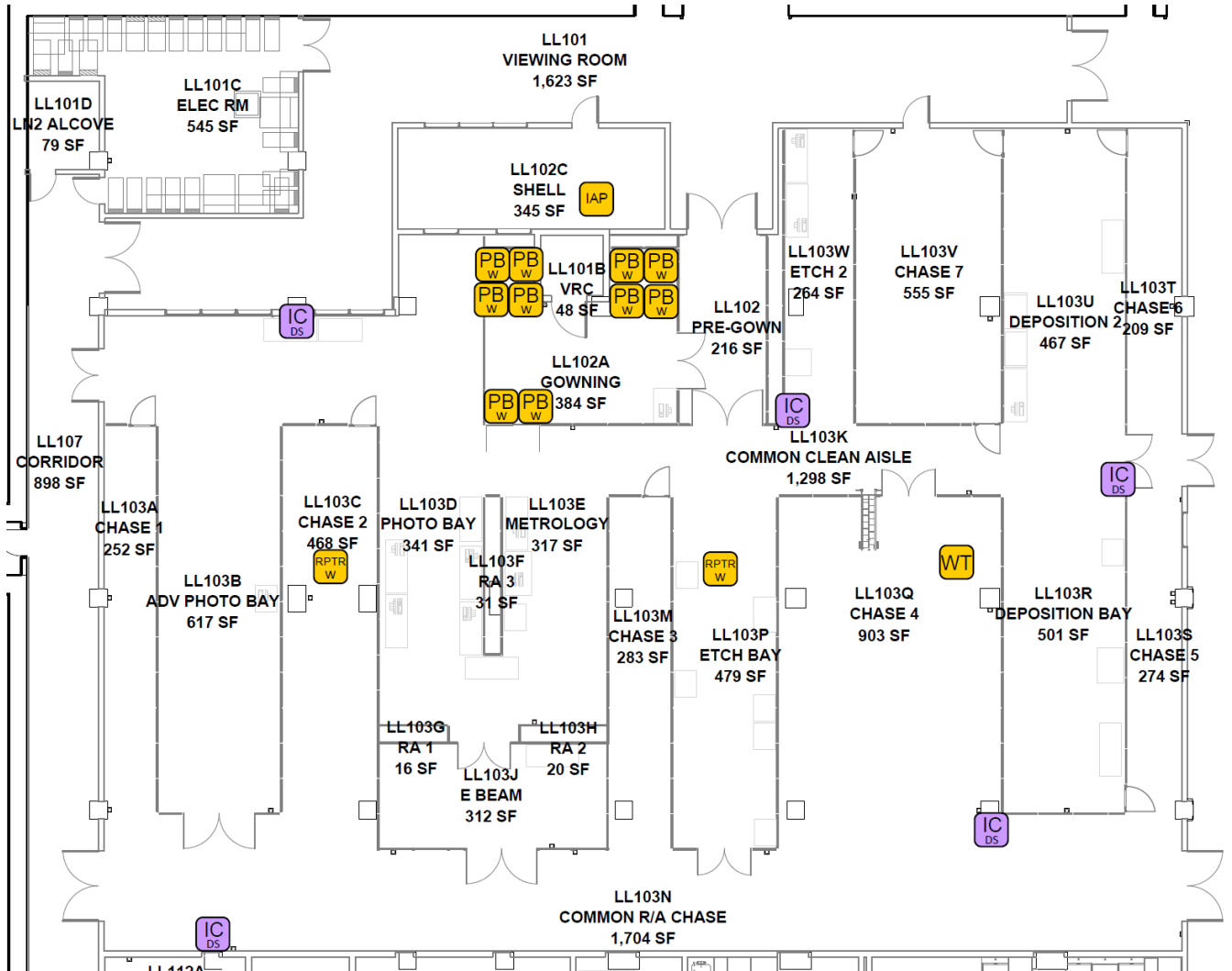


SS – Safety Shower

Emergency Egress Map for the Cleanroom



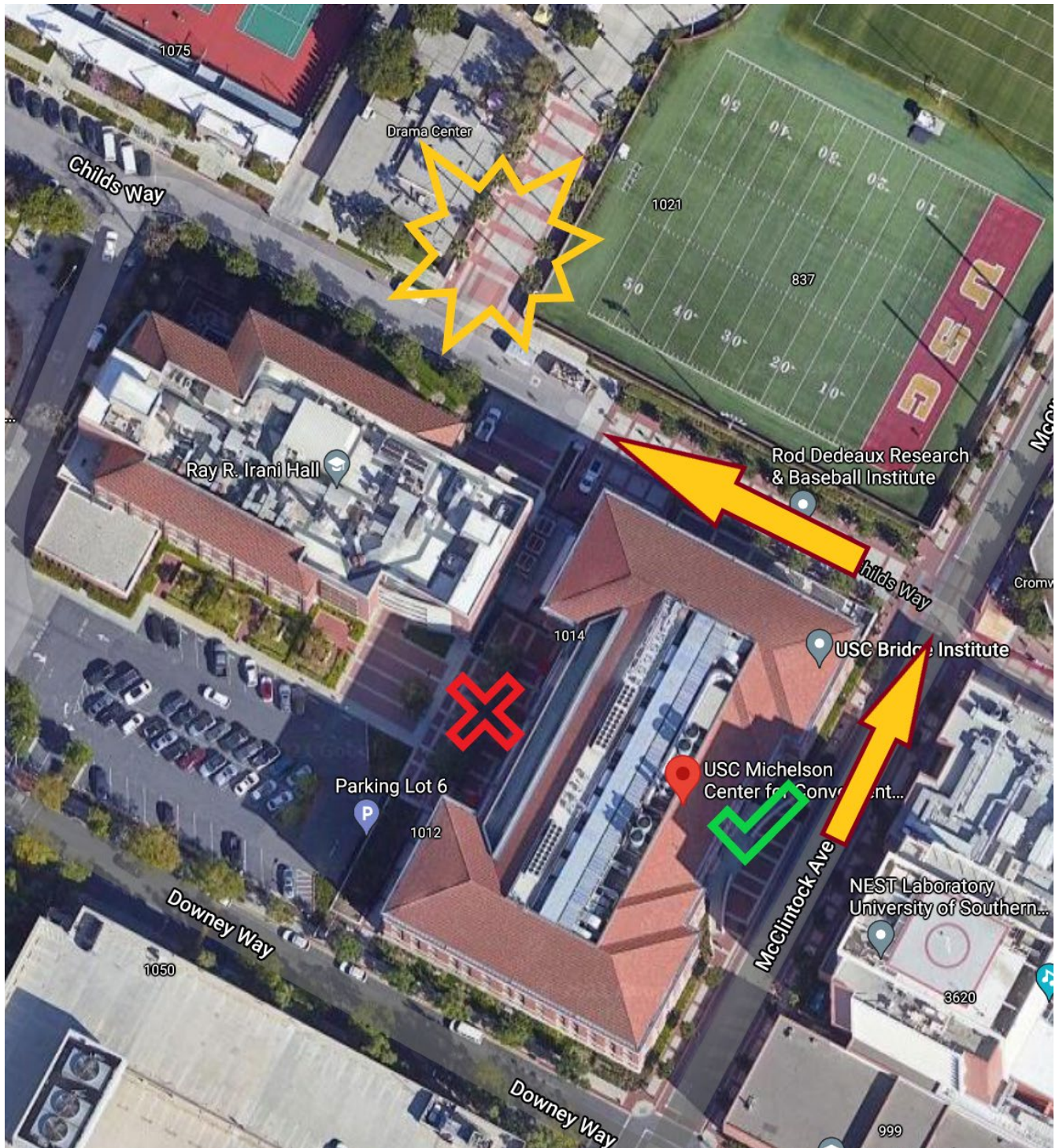
Emergency Phone for the Cleanroom



IC_{DS} – Emergency Phone

PB_w – Panic Button

Designated Safe Area – Emergency Assembly point (EAP)



Contributors	Revised Date
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