

Birck Nanotechnology Center

Operating Policies and Procedures

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1. INTRODUCTION

1.1. *WHAT IS THE BIRCK NANOTECHNOLOGY CENTER (BNC)?*

The Birck Nanotechnology Center is an 187,000 square foot research facility consisting of a nanofabrication cleanroom, a biocleanroom, heavy laboratory space, and office areas. One of the most advanced facilities of its kind in the world, it is designed to support collaborative multidisciplinary research in nanotechnology and to foster interaction between researchers and research disciplines.

The nanofabrication cleanroom is a bay-chase design, with clean zones ranging from ISO Class 3 to ISO Class 5. Additionally, it meets stringent vibration criteria and is furnished with ultra- and high-purity utilities. The nanofabrication cleanroom contains equipment for lithography, wet and dry etching, deposition, diffusion, and metrology. The nanofabrication cleanroom also contains a teaching facility for semiconductor processing.

The biocleanroom is a pharmaceutical-grade cleanroom that provides bio-contaminant control as well as particle control. Entered by a separate gowning area, there is access for materials to move between the nanofabrication cleanroom and biocleanroom.

The laboratory areas provide specialized facilities for non-cleanroom equipment and experimentation, including a nanotechnology measurement laboratory with world-class vibration and temperature controls, advanced surface-analysis capabilities, optical and laser systems, biological research facilities, materials deposition laboratories, electron microscopy facilities, and electrical characterization laboratories.

The offices and interaction areas are designed to provide convenient access to the cleanrooms and the laboratory facilities, and to provide support for multidisciplinary activities. Formal and informal interaction space has been designed into the common areas of the facility.

1.2. *OPERATING PHILOSOPHY*

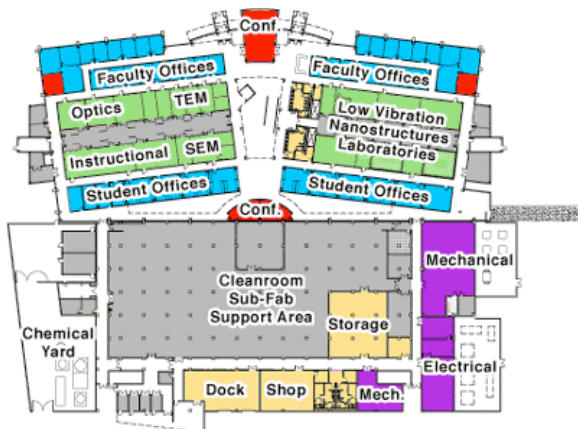
1.2.1. Birck Nanotechnology Center Policies Governing Space and Equipment

1. Laboratory and office space in the BNC building will be assigned by the Director and the Facility Manager.
2. Occupants of the BNC must maintain an active research program that utilizes equipment in the BNC or that benefits from close interaction with other occupants of the BNC.
3. It is expected that laboratory space and equipment in the BNC will be open to all qualified users, except in cases where such access adversely affects the cleanliness, safety, or functionality of the space or equipment.
4. Each laboratory and each item of equipment will be assigned a "Person-in-Charge" (PIC). The PIC will be the faculty member (or designee) most intimately involved with the use of the space or equipment. The PIC will establish rules governing access to the laboratory or equipment, including

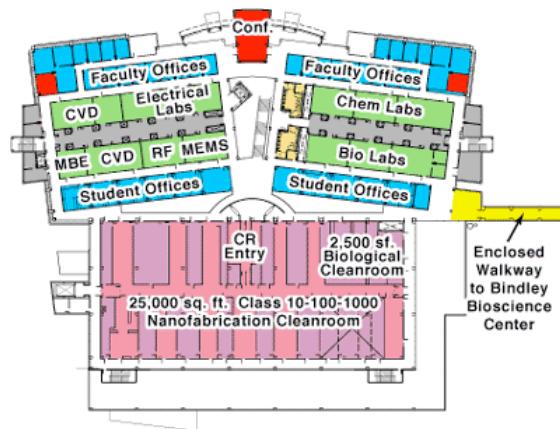
training requirements, scheduling, operational procedures, functional restrictions, etc. Such rules are subject to approval by the BNC Director.

5. In cases where equipment is shared by a large number of users, a user fee will be established to prorate the cost of maintenance among users proportional to their actual usage. The fee will be established by the PIC, subject to approval by the BNC Director, and will not exceed the actual per-use maintenance cost of that equipment. If a piece of equipment is restricted to a small group of users, that group can elect to provide their own maintenance. In such cases, no user fee will be charged. Equipment maintenance within the building will be managed centrally by the BNC. The BNC will fund and supervise a maintenance staff, and will collect user fees to offset the cost of maintenance
6. The BNC Director will act as the PIC of the cleanroom and will establish regulations governing access, training requirements, operational protocols, and penalties for violation of operating rules.
7. To support operating expenses of the cleanrooms, a per-semester cleanroom access fee will be charged. In cases where these fees would inhibit users from utilizing the facilities, users can apply to the BNC Directors for a waiver of fees. Each such request will be considered on an individual basis.

1.3. FUNCTIONAL AREAS



BNC First Floor



BNC Second Floor

1.3.1. Nanofabrication Cleanroom

The BNC nanofabrication cleanroom consists of a microelectronics bay-chase cleanroom with clean zones ranging from ISO Class 3 through ISO Class 5. A raised floor allows unidirectional airflow throughout the nanofabrication cleanroom and ultra pure utilities provide the cleanliness needed for nanotechnology research. The nanofabrication

cleanroom is entered from a pre-gowning area that connects to the gowning room, which in turn connects to the nanofabrication cleanroom. All three areas are restricted access.

1.3.2. Biocleanroom

The BNC biocleanroom consists of a pharmaceutical-grade bay-chase cleanroom. It has a gowning facility that is separate from the nanofabrication cleanroom, but is equipped with pass-through units to allow the passage of materials between the two facilities. The biocleanroom and the biocleanroom gowning area are restricted access.

1.3.3. Laboratories

The BNC laboratories are specialized facilities that support nanotechnology research with ultra pure utilities outside of a cleanroom atmosphere. The area between the laboratory modules is the galley, where services to the laboratories are located. The laboratories and the galley are restricted-access areas.

1.3.4. Subfab

The subfab is the support area for the nanofabrication cleanroom and the biocleanroom. It contains support equipment for the nanofabrication cleanroom and the biocleanroom equipment as well as the utility mains and branches for the nanofabrication cleanroom and the biocleanroom. The subfab is a restricted-access area.

1.3.5. Offices

The offices are located on the north side of the building, surrounding the laboratory areas, on both the first and second floor.

1.3.6. Common Areas

There are numerous common areas in the facility, designed to provide easily accessed locations for interaction among researchers. There are large conference rooms in the north-center portion of the building on each floor, and smaller conference rooms at the end of each office wing. There are two conference rooms in the center of the building on the first floor.

1.3.7. Support Areas

The entire third floor of the BNC facility is devoted to air handling equipment. Access to this floor is restricted. Additionally, there are numerous support areas that provide the services to the building, spread among the lower two floors. All of these areas are restricted access.

2. ACCESS AND REQUIRED TRAINING

2.1. BUILDING ACCESS – USERS AND VISITORS

All persons entering the BNC, whether users of the BNC facilities or visitors, must stop at the lobby area and read the orientation brochure or view the orientation slides online (see Appendix 2 for link). This information gives a capsule view of the facility and how to respond to an emergency situation.

All people entering the building must be familiarized with emergency information, building layout, and rules regarding controlled-access portions of the building.

2.1.1. Visitors in Groups

Visitors should be informed of emergency alarms & exits prior to touring the facility.

2.2. LABORATORY ACCESS AND TRAINING

Access to a laboratory in the BNC is granted only to those who have a need to work in that laboratory. A visitor may enter a laboratory provided they are accompanied by a certified user of that laboratory at all times, less than 4 hours. To gain access to a laboratory unescorted and/or to work in a laboratory, Laboratory Users' training (BNC 105 and BNC 150, sign up at: <http://www2.itap.purdue.edu/bnc/training>) is required. For access to any of the biolabs, additional training is required. To obtain this access level you may sign up for BNC 208A at <http://www2.itap.purdue.edu/bnc/training/>. For Biosafety Level 2 labs additional training is mandatory. A laboratory ID card and laboratory key will be issued when: 1) A message is sent to the Building Clerk from the PIC of that laboratory authorizing entry; and 2) The necessary training course(s) are completed. See Section 2.2.3 for policies pertaining to visitor access to the laboratories.

Only those who have access to individual laboratories have access to the service galley.

Some laboratory areas will have further restrictions on personnel entry, depending on the processes and equipment present in the laboratory.

2.2.1. Laboratory Users Training

Laboratory users are those who work in a laboratory on a regular basis, or those who work in a laboratory – even infrequently – when unaccompanied by a certified user. Also, anyone who has any contact with hazardous materials is considered a laboratory user.

Laboratory users must complete two courses prior to working in the laboratories: BNC-105 Laboratory Orientation and BNC-150 Fume Hood Safety Training. These courses include laboratory rules, principles of laboratory safety, and hazardous materials information. It is the responsibility of the laboratory users to ensure that they have received the appropriate safety information/training for any material or process before beginning an experiment.

Certified laboratory users will receive a color-coded badge indicating their certification. This badge must always be worn when entering a laboratory, and access to the laboratory can be achieved by 'swiping' this badge through the card readers near the lab doors. Note: every person entering a laboratory must swipe their own card on every entry.

Research done in individual laboratories is unique, and therefore, separate orientation, training and access badges for specific laboratories may be required.

A schedule of available training sessions can be viewed on the web at

www.nano.purdue.edu → Facilities → Training, or directly to the website sign up at <http://www2.itap.purdue.edu/bnc/training/>.

Members of the Purdue community can register for courses using their CAREER account. Non-Purdue / Outside users can register by setting up a “Friends of the University” account. Note: If a user does not enter the laboratory for a period of one year, then badge access is terminated and retraining is required prior to resuming work in the laboratories.

2.2.2. Visitors Access to Laboratories

Laboratory visitors are those people who enter a laboratory area under escort, and are accompanied by a certified laboratory user at all times. A laboratory visitor may not enter a laboratory unaccompanied, nor may he/she be left alone in a laboratory. Under no circumstances should a laboratory visitor have a laboratory key.

2.2.3. Training for Visitors to Laboratories

A visitor’s host is required to review all safety rules that apply to laboratories as well as general facility rules. The host is responsible for his or her visitor at all times and must ensure that safety protocols are followed. The visitor must be accompanied by the host at all times while in the laboratories.

Laboratory visitors may NOT handle chemically or biologically hazardous materials. Laboratory visitors must NOT handle any instrumentation while in the labs. They must comply with all posted rules for that laboratory.

2.3. NANOFABRICATION CLEANROOM ACCESS AND TRAINING

Nanofabrication cleanroom access is granted to those who have a need to work in the BNC nanofabrication cleanroom. To gain initial access to the nanofabrication cleanroom, register for the BNC 206 course, “Cleanroom Training,” at <http://www2.itap.purdue.edu/bnc/training/>. A nanofabrication cleanroom ID card and nanofabrication cleanroom garment set will be issued when the training and entry requirements have been satisfied.

Access to the nanofabrication cleanroom is limited to those whose work requires cleanroom entry. Visitors may view the operations of the cleanroom through the many viewing windows that have been designed into the cleanroom perimeter.

Entry to the BNC nanofabrication cleanroom requires the completion of specialized training. This training involves an on-line course as well as hands-on sessions. Training is provided for visitors to the nanofabrication cleanroom as well as for those who will work in the nanofabrication cleanroom for an extended period of time. The appropriate training course(s) must be completed prior to entry into the nanofabrication cleanroom. Note: If a user does not enter the nanofabrication cleanroom for a period of one year, then badge access is terminated and retraining is required prior to resuming work in the cleanroom. Also, if a user does not use a specific piece of processing equipment for a period of 6 months, then Coral access is terminated and the user must be recertified on

the equipment by going through the specific training for that equipment prior to using the tool.

Access to the nanofabrication cleanroom chases from outside of the nanofabrication cleanroom is not allowed. Chases may only be entered from within the nanofabrication cleanroom, and only BNC staff members or maintenance personnel are approved to enter the chase area. Exiting the cleanroom and/or cleanroom chases through the emergency exit doors is prohibited except in an emergency.

Entry into the subfab has the same restrictions as entry into the nanofabrication cleanroom. Access to the subfab is highly restricted; the subfab should only be entered by those who have a valid reason for entry. Nanofabrication cleanroom training is required for all persons who have access to the subfab, but only BNC staff members or maintenance personnel are approved to enter the subfab area

2.3.1. Nanofabrication Cleanroom Users

Nanofabrication cleanroom users are those who work in the nanofabrication cleanroom on a regular basis, or those who work in the nanofabrication cleanroom – even infrequently – when unaccompanied by a certified user. Also, anyone who has any contact with hazardous materials is considered a nanofabrication cleanroom user.

All nanofabrication cleanroom users must complete an online training course and quiz prior to attending cleanroom orientation. The course can be accessed on Purdue's "Open WebCT" system at <http://www.itap.purdue.edu/tlt/ecourses/open.cfm>. Registration questions should be directed to the Process and Equipment Manager. All nanofabrication cleanroom users must complete the course BNC-206 Nanofabrication Cleanroom Orientation prior to working in the nanofabrication cleanroom, regardless of previous experience. This course includes nanofabrication cleanroom procedures and rules, principles of nanofabrication cleanroom safety, and hazardous materials information. It is the responsibility of the nanofabrication cleanroom user to ensure that he/she has received the appropriate safety information/training for any material before using that material.

Nanofabrication cleanroom users will receive a BNC User badge that is coded for access to the nanofabrication cleanroom gowning room when training is complete and he/she is certified by the nanofabrication cleanroom staff. This badge allows nanofabrication cleanroom entry through operating the card reader at the gowning room entrance. The badge remains the property of the BNC, and must be surrendered on request. A second badge will be issued that is to be worn on the outside of the nanofabrication cleanroom garment at all times. The second badge is never to leave the nanofabrication cleanroom or gowning room area.

2.3.2. Visitors Access to Nanofabrication Cleanroom

Nanofabrication cleanroom visitors are those people who enter the nanofabrication cleanroom under escort, and are accompanied by a certified Birck Staff Member at all times. Such visitors are limited to equipment installation, servicing, and updates or must have a substantial need to enter the cleanroom. A visitor may not enter the nanofabrication cleanroom unaccompanied, nor may he/she be left alone in the nanofabrication cleanroom. Under no circumstances should a nanofabrication cleanroom visitor have a nanofabrication cleanroom entry badge.

2.4. BIOCLEANROOM ACCESS

Biocleanroom access is granted to those who have a need to work in the BNC biocleanroom. To gain initial access to the biocleanroom, contact the Process & Equipment Manager or the Facility Manager and the BNC Biosafety Officer. A biocleanroom ID card and biocleanroom garment set will be issued when the training and entry requirements have been satisfied.

2.4.1. Biocleanroom Training

Biocleanroom entry requires specialized training beyond the training received for nanofabrication cleanroom entry. The appropriate biocleanroom training course must be completed prior to entry into the biocleanroom.

2.4.2. Biocleanroom Users

Biocleanroom users are those who work in the biocleanroom on a regular basis, or those who work in the biocleanroom – even infrequently – when unaccompanied by a certified user. Also, anyone who has any contact with biohazardous materials is considered a biocleanroom user.

2.4.3. Biocleanroom User Training

Biocleanroom users who have not previously worked in a qualified cleanroom and have not completed “EE 557, Integrated Circuit Fabrication Laboratory” must complete the Cleanroom and Biocleanroom overview training prior to taking the biocleanroom entry training course(s).

All biocleanroom users must complete the course BNC Cleanroom Orientation and BNC Biocleanroom Orientation prior to working in the biocleanroom, regardless of previous experience. This course includes biocleanroom procedures and rules, principles of biocleanroom safety, and hazardous materials information. It is the responsibility of the biocleanroom user to ensure that he/she has received the appropriate safety information/training for any material before using that material.

Biocleanroom users will receive a BNC User badge that is coded for access to the biocleanroom gowning room when training is complete and he/she is certified by the biocleanroom staff. This badge allows biocleanroom entry through operating the card reader at the biocleanroom gowning room entrance. The badge remains the property of the BNC, and must be surrendered on request. A second badge will be issued that is to be worn on the outside of the biocleanroom garment at all times. The second badge is never to leave the biocleanroom or gowning room area.

2.4.4. Visitors Access to Biocleanroom

Biocleanroom visitors are those people who enter the biocleanroom under escort, and are accompanied by a certified biocleanroom user at all times. Such visitors are limited to equipment installation, servicing, and updates or must have a substantial need to enter the cleanroom. A visitor may not enter the biocleanroom unaccompanied, nor may he/she be left alone in the biocleanroom. Under no circumstances should a biocleanroom visitor have a biocleanroom entry badge. Visitor entry must be approved by Birck Staff in advance.

2.5. SPECIALIZED TRAINING REQUIREMENTS

In addition to the training requirements for entry into various portions of the facility, training courses are required for those performing specialized functions in the facility.

2.5.1. Specialized Laboratories

There are several recognized labs which require documented safety training through Purdue's Radiological and Environmental Management (REM). These areas include labs classified for Laser Use, X-Ray Diffraction Equipment, and Biohazardous Areas (BSL1 and BSL2). Please contact Birck Staff Management for specifics.

2.5.2. Equipment Training

Prior to operating equipment in the facility, specialized training is required. The training requirements for a piece of equipment are designated by the Process Owner for that equipment. It is the responsibility of the user to obtain certification on a piece of equipment prior to use. To obtain certification, register on-line for the appropriate training course at: <http://www2.itap.purdue.edu/bnc/training/>. After successful training, users will be allowed to use the equipment for a period of time set forth by the Process Owner. The Process Owner has the right to deny access to an individual user, if the Process Owner feels the user does not understand the procedure, or if the user fails to comply with the proper procedures. Access to equipment can be revoked by the Process Owner at any time due to failure to comply with facility or equipment rules.

2.5.3. Nanofabrication Cleanroom and Biocleanroom Housekeeping

Housekeeping personnel working in the nanofabrication cleanroom or the biocleanroom must receive specialized training and certification. This certification must be received prior to working in the nanofabrication cleanroom or biocleanroom.

2.5.4. Nanofabrication Cleanroom and Biocleanroom Maintenance and Equipment Installation

All personnel performing maintenance functions and/or equipment-installation functions within the nanofabrication cleanroom and/or biocleanroom must receive specialized training and certification. This certification must be received prior to working in the nanofabrication cleanroom or biocleanroom. A separate document, the BNC Equipment Installation Manual, provides guidance on maintenance and installation materials and procedures.

2.5.5. Emergency Response

Select BNC professional staff members have had specialized training related to building emergencies and evacuations due to hazardous conditions that could infrequently occur. This training includes the use of breathing apparatus and emergency response protocols. This team of trained professionals is known as the "Emergency Response Team" (ERT).

2.6. BADGES

2.6.1. BNC User Badge

Badges will be issued to all certified users of the BNC nanofabrication cleanroom, BNC biocleanroom and BNC laboratories. The BNC User Badge will have the user's name and a magnetic strip that is coded to the user's access levels. These badges are the property of the BNC and Purdue University, and must be surrendered on request. A fee will be charged for lost badges to cover the cost of a replacement badge as well as for the recoding associated with invalidating the lost badge.

The BNC User Badge will provide card-access to the facility during off hours. If the user is certified for nanofabrication cleanroom, biocleanroom, or laboratory entry, it will also provide card-access to these areas.

2.6.2. BNC Nanofabrication Cleanroom Badge

The BNC nanofabrication cleanroom badge is to be worn on the nanofabrication cleanroom garment at all times. When leaving the nanofabrication cleanroom, the badge is to remain in the nanofabrication cleanroom gowning room. This badge does not provide access to the gowning room entry card reader.

2.6.3. BNC Biocleanroom Badge

The BNC biocleanroom badge is to be worn on the biocleanroom garment at all times. When leaving the biocleanroom, the badge is to remain in the biocleanroom gowning room. This badge does not provide access to the gowning room entry card reader.

3. SAFETY AND EMERGENCY RESPONSE PROCEDURES

Hazardous production material (HPM) is defined by the Indiana Fire Code as "A solid, liquid, or gas associated with semiconductor manufacturing that has a degree-of-hazard rating in health, flammability, or reactivity of Class 3 or 4 as ranked by UFC Standard 79-3." This definition is implied when the term *hazardous material* is used in this document. (See Appendix 3 for examples of commonly used BNC hazardous materials.)

3.1. SAFETY SYSTEMS

3.1.1. Air Monitoring

A fixed air monitoring system monitors for gaseous chemical releases at the points most likely to sense such a release. Typically, the sensor is placed in the exhaust duct just downstream of a potential release point, such as a valve inside an equipment enclosure. For toxic gases, the warning limit is set at 25% the threshold limit value (TLV) for that gas and the evacuation limit is set at 50% the TLV for the gas. For flammable gases, the

warning limit is set at 10% the lower flammability limit (LFL) of the gas and the evacuation limit is set at 20% the LFL for the gas.

3.1.2. Exhaust Ventilation

Exhaust ventilation is provided at all locations where hazardous liquid chemicals or hazardous gases are in use. The static pressure and flow rate of this ventilation is maintained in compliance with the Purdue University Chemical Hygiene Plan (CHP).

3.1.3. Fire Protection

Pull stations, extinguishers, Automatic External Defibrillators (AED's) are provided for use by trained individuals. Please see a building map for their locations.

3.2. *EMERGENCY FACILITIES*

3.2.1. Emergency Response Team (ERT) Room

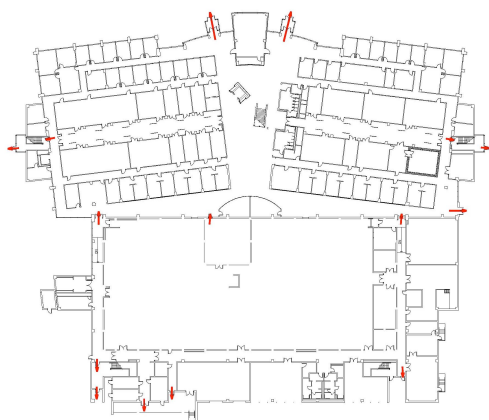
In case of emergency, the ERT meeting point is outside the South East entrance to the Birck Nanotechnology Center near Room 1137. This area is the meeting point for emergency responders only, and in the event of a cleanroom or building emergency it may serve as the command post to coordinate the actions of staff and emergency responders, depending on the nature of the emergency. In some cases, a command post will be established away from the building.

Building emergency panels are located inside the southeast entrance to the building for use by emergency responders.

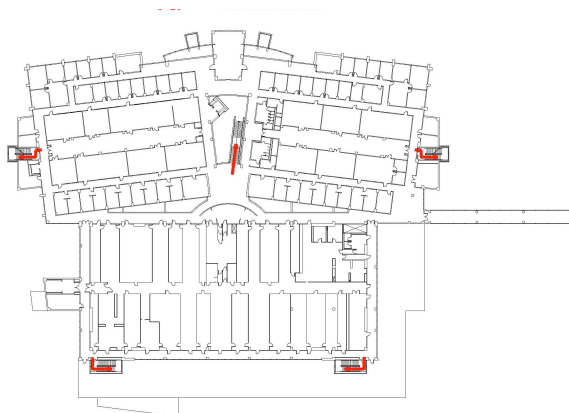
3.2.2. Emergency Access

When practical, emergency responders will consult with the Cleanroom Staff and/or Laboratory Staff before entering the facility. For gaseous- or liquid-chemical emergencies, it is strongly recommended that a staff member be contacted prior to emergency responders entering the facility.

3.2.3. Emergency Exit Locations



BNC First Floor Exits



BNC Second Floor Exits

3.3. **EMERGENCY PROCEDURES**

Please note: The information contained in this document is a supplement to the Purdue University Emergency Procedures Handbook. This handbook can be accessed from the following link or by contacting Radiological and Environmental Management (REM) at 46371.

<http://www.purdue.edu/physicalfacilities/emergencycontacts.php>

3.3.1. Evacuation Procedures

Emergency Action

1. When the alarm sounds, leave the building immediately.
2. Alert others to the emergency and ask if they will need help in evacuation.
3. Do not use elevators unless instructed to do so by emergency personnel.

NOTE: It is suggested that people with disabilities prepare for emergencies by learning the locations of exit corridors and enclosed stairwells and by informing co-workers, professors, and/or classmates of best methods of assistance during an emergency.

If you wish to have assistance in preplanning please call the Fire Department at (765) 494-6919.

3.3.1.1 Initiation of an Evacuation

The evacuation of the facility can be initiated through pulling a fire-pull station or activating an Emergency Gas Shutoff switch. Emergency responders will be automatically summoned.

The evacuation of the facility is automatically initiated when the “danger” alarm level is detected by the hazardous gas monitoring system. For details regarding this level, see Section 3.1.1 Air Monitoring above.

The fire evacuation alarm is a siren tone, similar to the siren on a police or fire vehicle. The toxic gas evacuation alarm is beeping tone. A supplemental voice message will also announce the evacuation.

3.3.1.2 Response to Evacuation Alarm

DO NOT USE ELEVATORS during an emergency evacuation. When the building evacuation alarm is sounded or when told to leave by a designated emergency official or staff member, walk quickly to the nearest marked exit and ask others to do the same.

Once outside, **MOVE CLEAR OF THE BUILDING ALLOWING OTHERS TO EXIT**, then move immediately to main (southwest) entrance area of the Burton Morgan Entrepreneurship Center (Venture Café area) to the northeast of the BNC (See Map in

Appendix 5). This gathering point will be used to ensure that all people safely evacuated the building, so it is critical that you come to this location so that you can be logged out of the building.

Please be aware of people with disabilities in your area that might require assistance during an evacuation. Please assist them as needed.

IF YOU HAVE A DISABILITY AND ARE UNABLE TO EVACUATE:

Stay calm, and take steps to protect yourself. If there is a working telephone, call 911 and tell the emergency dispatcher where you are **or** where you will be moving. If you must move, we recommend the following:

1. Move to an exterior enclosed stairwell.
2. Request persons exiting by way of the stairway to notify the Fire Department of your location.
3. As soon as practical, move onto the stairway and await emergency personnel.

3.3.1.3 *All-Clear Signal*

Please do not re-enter the building until the all-clear announcement is given by a uniformed Purdue Police or Fire Officer. Do not re-enter the building based on guidance from any other person.

3.3.1.4 *Emergency Responders*

There are several volunteer and professional teams within the BNC who respond to emergency situations in the facility. To volunteer for one of these teams, please contact the BNC Safety Manager or REM at 46371.

3.3.2. *Fire*

In preparation for a potential fire emergency, know the location of pull stations, fire exits, and alarm systems in your area and know how to use them.

Do not fight the fire. Make sure the Fire Department has been called and the building alarm has been sounded. In all cases, possible injury and excessive risks should be avoided.

If you become trapped in a building during a fire:

1. Stay calm, and take steps to protect yourself.
2. If possible, move to a room with an outside window.
3. If there is a telephone, call 911 and tell the dispatcher where you are. Do this even if you can see fire department personnel from the window.
4. Stay where rescuers can see you through the window, and wave a light-colored item to attract their attention.
5. Stuff clothing, towels or paper around the cracks in the door to help keep smoke out of your refuge.
6. Be patient. Rescue of occupants within large structures will take time.

Fire Life Safety Equipment

Sprinkler systems and water flow detection devices are present throughout the BNC.

Water flow in these devices is monitored by University Emergency Dispatch Center and automatically triggers a response.

Smoke detectors are installed throughout the BNC.

Manually activated fire alarm pull stations are located at all exit points. If any sprinkler, heat detector, or pull station is activated, an alarm will sound throughout the building. Smoke detectors will also activate the building alarm. .

Elevator Fire Control may cause the building elevators to respond differently. DO NOT attempt to use the elevators to evacuate any building. If you are on an elevator when the emergency alarm sounds, exit the elevator when it stops and leave the building via the emergency exit route.

Emergency lighting will activate automatically in a power failure and last for a minimum of 90 minutes.

Illuminated exit signs indicate proper emergency exit paths.

3.3.3. Hazardous Spills/Release

3.3.3.1 *Liquid Chemical Spills*

A liquid chemical spill is defined as the release of a finite amount of liquid outside its primary and secondary containment. For example, a beaker of a chemical tipping over inside a hood that is fully contained by the hood is not a spill. Conversely, if the beaker tips over in such a way that liquid runs down the front of the hood that is a spill.

3.3.3.1.1 Laboratory Spills

All liquid chemical spills within the laboratory areas must be reported to a Laboratory Staff member immediately. The laboratory staff member will remediate the spill and report the spill to Purdue Fire Department, if necessary.

If the laboratory spill is of sufficient quantity to present a danger to the occupants of that laboratory, or if fumes and/or vapors from the spill are causing adverse symptoms to that laboratory's occupants, all people in that laboratory must leave. The entrances to the laboratory are to be guarded or blocked with an "Emergency Spill" pylon until the remediation efforts are completed.

3.3.3.1.2 Cleanroom Spills

All liquid chemical spills within the cleanroom must be reported to a Cleanroom Staff member immediately. The cleanroom staff member will remediate the spill and report the spill to Purdue Fire Department, if necessary. It is critical that the raised-floor panels and the sub floor area be properly cleaned following a spill.

If the cleanroom spill is of sufficient quantity to present a danger to cleanroom occupants, or if fumes and/or vapors from the spill are causing adverse symptoms to cleanroom occupants, an evacuation of the cleanroom is to be initiated. Follow the procedures listed in the Cleanroom Evacuation section of this document. (See Section 6.8)

3.3.3.1.3 Biohazardous Spills inside of BSL1 and BSL2 labs

A minimally biohazardous material that is spilled without generating significant aerosols may be cleaned up with a paper towel soaked in an effective decontaminating agent (10% bleach or commercial virucide/bactericide). A spill of a large volume of biohazardous material (generally 50 milliliters or more) with the generation of aerosols will require evacuation of the area and closing off the area. Clean up personnel wearing protective clothing and respiratory protection will be required to come in to decontaminate.

Users should always be aware of the biological agents and their potential hazards when working with them in any quantity. With M. tuberculosis, for example, the risk of exposure from the spill of a small quantity might be many times that of a much larger spill of E. coli. Therefore, if the agent is known, the recommended procedure and protective equipment should be used. If in doubt as to the danger level, treat as if it is the more dangerous material. Please contact the Birck Biosafety Officer for any biohazardous material spill >50mL which occur in a Birck Biosafety Lab (BSL).

BIOHAZARDOUS MATERIAL SPILLS WITHIN A BIOLOGICAL SAFETY CABINET

1. Initiate cleanup at once, while the cabinet continues to operate, using an appropriate disinfectant such as a 1 to 10 solution of household bleach in water. Avoid the use of organic solvents (alcohols) as a first step in decontamination. 70% EtOH may be used only AFTER the initial cleanup to surface sterilize the hood.
2. Prevent the generation and escape of aerosols and contaminants from the cabinet during decontamination. Work well within the hood's workbench – away from the front grill.
3. For large spills (greater than 50 milliliters), formaldehyde gas decontamination can be used for final decontamination (arranged by REM). Notify the Birck Biosafety Officer about the spill and close off the area. The Biosafety Officer will notify REM to schedule a decontamination process.

BIOHAZARDOUS SPILLS INVOLVING AGENTS REQUIRING BIOSAFETY LEVEL 2:

1. Evacuate the room immediately, close doors, remove all contaminated clothing, and place in a designated biohazard spill bag located near the exit. Decontaminate any body surfaces that may have been contaminated using germicidal soap and water.
2. Allow enough time (at least 30 minutes) for droplets to settle and aerosols to be reduced by the ventilation system before re-entering.
3. Don protective clothing including a face shield.
4. Decontaminate the spill with an appropriate disinfectant (e.g. 1:10 solution of household bleach in water or approved bactericide/virucide/fungicide).
5. Decontaminate and dispose of contaminated items by placing them in an orange autoclavable biohazard bag and closing it up with a twist tie or tape.
6. Following cleanup, responders should wash or shower with a germicidal soap and water. All contaminated material in the biohazard bag should be autoclaved as soon as possible in Bindley Bioscience Center, Room 233.

NOTE: REM must be consulted as part of the cleanup procedure.

3.3.3.1.4 Bodily Fluid Spills outside of the BSL2 Labs

If you witness a bodily fluid spill, or if you discover a bodily fluid in the facility, DO NOT attempt to clean up the fluid spill yourself. Instead contact the Birck Biohazard Safety Officer immediately and follow the Purdue University Bloodborne Pathogen procedures: Mark the area with yellow Biohazard Tape and notify personnel within the affected area. The Birck Biohazard Safety Officer will take care of the spill if the volume is not greater than 50 milliliters. Large spills will require assistance from REM for cleanup and documentation.

3.3.3.2 *Hazardous-Gas Release*

The release of a hazardous gas requires an immediate evacuation of the building. Please activate the Emergency Gas Shutoff buttons as you are exiting the building. Follow the evacuation procedures in Section 3.3.1 of the document.

3.3.4. Medical Emergency

EMERGENCY ACTION

1. **Call 911** or use Emergency Call Box and report incident.
2. Do not move the patient unless safety dictates.

Fire Department personnel are trained certified Emergency Medical Technicians. They will respond to medical emergencies on campus. Any injury occurring as a result of an existing hazardous condition should be reported to the Purdue Police Department.

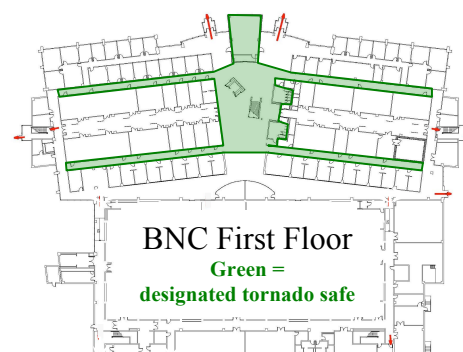
Request emergency medical assistance by calling the Emergency Dispatch Center at 911.

The individual making the call should make every effort to stay on the phone with the dispatcher and answer as many questions as possible regarding the condition of the injured person so that information can be forwarded to the responding emergency personnel.

The Purdue University Fire Department maintains an Advanced Life Support Transport Service. Medical emergencies should not be transported in personal or University vehicles. The ambulance is on call 24 hours a day.

3.3.5. Tornado/Take Cover Alarm

EMERGENCY ACTION



1. Move to the lowest level or interior corridor.
2. Stay away from windows.
3. Do not call 911 unless you require emergency assistance.

3.4. GAS AND CHEMICAL DELIVERY SAFETY PROCEDURES

3.4.1. Gas Cylinder Changing Procedures

Gas cylinders must be changed by designated, trained personnel. BNC Users should NOT attempt to change a gas cylinder at any time.

All compressed gas cylinders should be treated as a potential energy source and handled as a potential projectile. Gas cylinders must remain securely chained to a wall when in use. If multiple cylinders are stored in the same area, they must be tightly nested and secured with an external chain. Transport of gas cylinders requires an approved cart or dolly and the cylinder valve must be protected by a cylinder cap. Do not transport gas cylinders with a regulator attached.

3.4.2. Chemical Delivery

New chemical deliveries will be supervised by the BNC Safety Manager only. DO NOT bring chemicals into the facility unless you are working through the Safety Manager. Chemical samples brought into the facility must be approved through the Safety Manager.

Bringing chemicals into the facility in an unauthorized manner will result in sanctions.

4. UNIVERSAL BIRCK PROCEDURES FOR ALL RESEARCH AREAS

THE FOLLOWING PROCEDURES APPLY TO ALL THE LABORATORIES, THE NANOFABRICATION CLEANROOM, AND THE BIOCLEANROOM. THERE ARE ALSO SPECIFIC PROCEDURES REQUIRED FOR EACH AREA, ARE DESCRIBED INDIVIDUALLY IN SEPARATE SECTIONS.

4.1. ACCESS

Access to the laboratories, the nanofabrication cleanroom, and the biocleanroom is strictly controlled and considered a privilege at Birck. All users are expected to adhere to a high standard of ethics, safety protocol, and lab courtesy to obtain and retain access to any of the facility's aforementioned areas. Access and Training is described in Section 2.

4.1.1. Revocation of Access Privileges

User safety and the maintenance of shared equipment are the primary concern of all BNC members. To this end and to ensure uninterrupted research, Safety and Equipment Protocols are taken very seriously. The Process and Equipment Owners (Cleanroom Staff and Laboratory Staff) and/or faculty members have the right to immediately restrict access privileges of any user who violates laboratory, nanofabrication cleanroom, and biocleanroom or University policies. The disciplinary procedure is outlined below.

All access revocations will be reviewed by the disciplinary committee which is comprised of 4 faculty members and the facility manager. A log of violators will be kept by the chairperson of the disciplinary committee.

Sanctions for serious and/or repeated violations can be up to, and including, permanent expulsion from the laboratories, the nanofabrication cleanroom, or the biocleanroom. Suspensions are further discussed in Section 4.3.

4.1.2. Safety Training Documentation

No one will be allowed access to the laboratories, the nanofabrication cleanroom, or the biocleanroom until they have submitted documentation to the BNC Safety Manager certifying that they have received proper safety training. Appropriate safety guidelines issued by, but not limited to, the BNC, Purdue CHP, OSHA, and NFPA will be followed. Information on training required for specific labs can be obtained by contacting the Birck Training Coordinator.

4.1.3. Equipment Competency and Certification

No one will be allowed to use any piece of equipment in the laboratories, the nanofabrication cleanroom, or the biocleanroom unsupervised until they have demonstrated their competency to the Process Owner of that particular piece of equipment and have achieved certification on that equipment. See Section 2.5.1

4.1.4. Financial Arrangements

No one will be allowed access to any of the laboratories, the nanofabrication cleanroom, or the biocleanroom until they have provided a valid account number or made other suitable financial arrangements. It is the responsibility of the user to make sure the account number stays valid. Any account number that is found to not be valid will result in suspension of laboratory privileges

4.1.5. Super Users

Super Users will be identified by our engineering staff members for each of the main tools in the cleanroom and labs. The role of a Super User is to help train new students and assist staff members. Super User status will be evaluated on a month-by-month basis. If the Super Users spend at least 6 hours supporting staff they will receive double reservation time for their own equipment use during that month, and free monthly lab or cleanroom access (depending where their tool is located). This is tracked using Coral and reported monthly.

4.2. LABORATORY, NANOFABRICATION CLEANROOM AND BIOCLEANROOM RULES

Emergency

IN THE EVENT OF AN EMERGENCY, CALL 911.

4.2.1. Operational Hours

The normal cleanroom hours of operation are from 7:00 AM until 12:00 midnight Monday through Friday and from 12:00 noon until 12:00 midnight on Saturdays and Sundays. Working in the cleanroom outside of those hours requires the user to be accompanied by another cleanroom-approved individual who will serve as a ‘safety buddy’ as there are no staff members or lab attendants in the facility at these times.

While the laboratories are open at all times, hazardous materials work may only be performed from 7:00 AM until 12:00 midnight Monday through Friday and from 12:00 noon until 12:00 midnight on Saturdays and Sundays. Working with hazardous materials and working in chemical fume hoods outside of those hours requires the user to be accompanied by another cleanroom-approved individual who will serve as a ‘safety buddy’ as there are no staff members or lab attendants in the facility at these times.

4.2.2. New Chemicals

No new chemicals – solid, liquid, or gaseous – will be introduced into the laboratories, nanofabrication cleanroom, or biocleanroom without the approval of the Equipment and

Process Manager and the Safety Manager. This includes different concentrations/blends or grades of an existing chemical.

All new chemicals will be ordered by the Inventory Control Clerk, and received and placed in initial storage by the Inventory Control Clerk. If chemicals are non-standard for specific individual or group use only, the ICC will deliver to or inform the chemical owner of the arrival of chemicals.

Users should process all new chemical orders using Birck's online chemical management system.

<https://engineering.purdue.edu/NANO/ChemMgmt>

Search for the chemical of interest in the ChemMgmt data base. If it is not currently stocked at BNC, fill out the "Add Chemical/Material Form". This process requires vendor contact information as well as an electronic copy of the chemical's Material Safety Data Sheet (MSDS). Furthermore, the Safety Manager will require a Standard Operating Procedure (SOP) before approving new chemicals for use in a BNC lab.

Before a new chemical is used in the facility, the chemical must be approved for use, the MSDS must be on file in the master file and near the location of use, the chemical must be listed on the inventory for the appropriate laboratory, nanofabrication cleanroom or biocleanroom, and all people working in that laboratory, nanofabrication cleanroom or biocleanroom must be trained on the safety aspects of the chemical.

4.2.3. Existing Chemicals

All general laboratory chemicals are purchased by the Logistics Coordinator (LC); separate purchases by individual researchers are prohibited. This prevents unnecessary confusion and large inventories. A partial list of chemical supplies maintained by Birck Staff can be found in Appendix 1. To request that chemical supplies in a given area be replenished, use the Chemical Management site at

<https://engineering.purdue.edu/NANO/ChemMgmt>

The LC will process all requests and restock supplies within 24 hours.

The Process Owner, the Safety Manager, and the Equipment and Process Manager reserve the right to terminate the use of any chemical in any and all laboratories if it is determined to be unsafe or if it interferes with another process.

4.2.4. New Processes

No new materials or processes may be introduced into the laboratories, nanofabrication cleanroom or biocleanroom without the approval of the Equipment and Process Manager and the Safety Coordinator. Every reasonable accommodation for new processes will be provided, but the safety and the cleanliness of a given system must be maintained.

The Process Owner and the Equipment and Process Manager reserve the right to terminate any process in any and all laboratories, the nanofabrication cleanroom, or the biocleanroom if it is determined to be unsafe or if it interferes with another process.

4.2.5. Personal Protective Equipment (PPE)

Personal protective equipment must be worn in accordance with standard procedures for the laboratories, the nanofabrication cleanroom and the biocleanroom, and the

requirements listed on the MSDS for the chemical(s) in use. **THE MSDS FROM THE MANUFACTURER OF THE MATERIAL MUST BE CONSULTED TO DETERMINE MINIMUM PPE REQUIREMENTS.**

For hazardous liquid chemical usage, personal protective equipment (PPE) consists of splash- proof goggles, apron and sleeves or apron with sleeves, and chemical-resistant gloves. If a user is pouring chemicals and/or performing operations with a higher risk of chemical exposure, a face shield must be added to the above PPE. The chemicals must be used in a vented chemical hood.

When there is a risk of hazardous gas exposure, such as changing hazardous gas cylinders or maintaining hazardous gas systems, PPE consists of a self-contained breathing apparatus (SCBA). This will include a portable (backpack) breathing-air cylinder and may include an air-line cart. Only those people certified by REM and/or the Purdue Fire Department, in the usage of SCBA may use SCBA. A minimum of two qualified persons must be present when performing these duties.

4.2.6. Required PPE for the Laboratories

At all times while working in the laboratories, all personnel are required to wear eye protection. The sole exception to this rule is equipment labs without fume hoods or pressurized gasses (including house nitrogen). Splash-proof goggles are required while working in front of fume hoods. Face shields and splash-proof goggles are required when pouring chemicals.

Appropriate chemical-resistant gloves must be worn when working with any chemical.

Chemical-resistant aprons are required when working with corrosive chemicals. Lab coats are required when working with solvents.

Wavelength-specific protective eyewear must be worn while in a laboratory with an operating laser.

4.2.7. Chemical Usage Rules

In the laboratories, the nanofabrication cleanroom, or the biocleanroom, when using chemicals, empty one bottle before opening another. This has a direct effect on safety issues, storage efficiency, and cost.

4.2.7.1 *Empty Chemical Bottles*

When an acid or caustic bottle is emptied, rinse it inside and outside three times with deionized water in an acid hood, dry the outside of the bottle and attach a yellow “Safe For Disposal” tag, and place it in the appropriate waste/recycling bin (red).

When a solvent bottle is empty, blow dry the inside using house nitrogen such that no residual liquid remains, attach a yellow “Safe for Disposal” tag, and place in the appropriate waste/recycling bin (red).

4.2.7.2 *Chemical Waste*

Containers of waste chemicals must be labeled with the standard orange label. Waste chemical containers must NOT have a yellow “Safe for Disposal” label visible – these labels are only for empty bottles (see Section 4.2.7.1). Each of the materials in the container must be listed by its full name and approximate volume of solution added.

Containers of waste chemicals must be capped at all times, unless expressly adding waste solution to the bottle. Do not leave funnels in waste containers and do not leave containers uncapped. All bottles placed in the waste chemical cabinets or other receptacles must be labeled.

4.2.7.3 *Material Safety Data Sheets*

In accordance with federal and state law each chemical manufacturer is required to provide the users with a Material Safety Data Sheet (MSDS) for all chemicals or compounds they manufacture. This sheet contains information on the name, physical characteristics, health hazards, reactivity and compatibility along with disposal requirements etc. BNC Staff are responsible for maintaining a file of MSDSs on all currently used materials. Files may be kept using hardcopy or downloaded electronic copies. These files shall be maintained in the galley with immediate access to all individuals working in that laboratory wing. MSDS information shall be updated as new information is received or electronic updates are made available. For details consult the Chemical Hygiene Plan and the Hazard Communication Program that could be found on the REM homepage under the industrial hygiene area at

<http://www.adpc.purdue.edu/PhysFac/rem/ih/ih.htm>.

It is the responsibility of the user to read all relevant MSDS *before* handling chemicals and to take appropriate precautions before initiating an experiment.

4.2.7.4 *Compressed Gas Cylinders*

Compressed Gas Cylinders: All compressed gas cylinders shall be handled as potential energy sources. This requires specific operating procedures and practices for inspection, transportation, storage, change-out and emergency handling.

All gas cylinders will be changed by laboratory staff. Gas cylinders must be properly secured when in use and when staged. Transport of cylinders must be by an approved cart with cylinder properly secured and cap securely attached.

Equipment users should monitor supply levels on a regular basis and request replacements 48 hours in advance of planned use.

4.2.8. Certification for Equipment Use

The Birck Nanotechnology Center utilizes a software system called “Coral” to organize equipment use, billing, reservations, etc. Prior to training in the Birck Nanotechnology Labs or Cleanroom, access to the Coral Software is required. The person with signature authority for the account to be charged (typically the PI) must complete the form at <https://engineering.purdue.edu/NANO/coral>.

In the laboratories, the nanofabrication cleanroom and the biocleanroom, equipment may only be used unsupervised by those certified on that piece of equipment. To become certified on a piece of equipment, contact the Process Owner responsible for the equipment and schedule a training session. Training can also be scheduled via the training website at: <http://www2.itap.purdue.edu/bnc/training/>. Successful completion of the training and passing the proficiency evaluation leads to certification. Upon certification by the process owner, the user’s login will be qualified in Coral. An asterisk will appear next to any authorized equipment name in Coral.

The Process Owner reserves the right to terminate certification of a user. Termination of a user's certification will be based on the inability of user to safely operate the equipment or on a violation of equipment policies. If the user is determined to be incapable of operating any particular equipment safely, the certification will be terminated immediately. Recertification on any piece of equipment may be required after operational or safety updates, or after an extended period of non-use by the user. The operational and safety updates, as well as the expiration of certification on a piece of equipment are determined by the Process Owner. To renew certification, contact the Process Owner.

4.2.9. Reserving Equipment

The reservation policy for each piece of equipment can be found in the Coral hierarchy. Reservations must be continuous in time. For exceptions to the reservation policies, contact the Process Owner of the equipment. Coral allows the Process Owner to grant exceptions on a case-by-case basis. In the laboratories, the nanofabrication cleanroom, or the biocleanroom, be realistic and conscientious when signing up to reserve equipment.

Cancellation of an equipment reservation less than four hours prior to the scheduled use is considered a "no show." Repeated no-show occurrences may result in forfeiture of your ability to sign up for equipment.

4.2.10. Staff Collaboration

Each resident faculty at Birck will receive 8 free hours of "technical staff" time per fiscal year to help with their research projects in the cleanroom and/or laboratories. Faculty who are heavy users will get an additional 8 hours for every \$100K they spend in recharge. This will be tracked in Coral and reported monthly.

Log Books/Online Equipment Log

Fill out logbooks completely and legibly. It may be tedious to fill in all the blanks, but the information you provide can speed up troubleshooting and greatly reduce equipment down time.

Laboratory access may be suspended for failure to completely and legibly fill out log sheets.

4.3. CONSEQUENCES OF RULE VIOLATIONS

The Birck Nanotechnology Center is a collaborative research center, which offers a unique opportunity for multidisciplinary research in a wide array of nanotechnologies. It also serves as a training ground for new researchers where they can develop and hone laboratory and cleanroom skills and techniques through the progression of their research projects. The working environment within the Birck facility is one of cooperation and teamwork. This concept extends across student groups, faculty, and the Birck staff. The Birck Center is a multi-user facility that affords researchers access to a wide variety of high-tech fabrication, characterization and measurement tools. Because of the multi-user nature of our facility, we must be particularly diligent in keeping equipment and facilities

in top condition and ready for the next user. This requires a discipline and mind-set from all users to make sure they use the equipment in a responsible and professional manner, and then leave the equipment in good working condition when they're finished.

We understand that many laboratory and cleanroom techniques are unfamiliar and new, and that each student is on a learning curve as they progress through their research experience. However, deliberate and/or repetitive destruction of equipment or facilities, or continued safety violations that could endanger the student or other users of the facility must be dealt with by Birck management.

4.3.1. Safety Violations:

Safety violations are serious in that they can endanger a few or many people in the facility. For most first safety violations, the user will be reminded of the proper procedure and verbally corrected immediately. If the same user has a second violation then they will be issued a corrective e-mail by the Process and Equipment Manager, with a copy to their Faculty Advisor. Third violations by the same user will result in some period of expulsion from the labs and/or cleanroom. The period of expulsion will be decided by the Process and Equipment Manager and the Birck Director. More serious safety violations will be handled at the discretion of the Process and Equipment Manager and the Birck Director.

4.3.2. Procedural Violations

Procedural violations many times cause delays in subsequent research due to the necessity of cleaning, fixing, and/or decontaminating equipment that has been mistreated by the previous user. This can also lead to erroneous research results due to out-of-specification materials being processed. For the first violation the user will be corrected verbally. The second violation will result in a corrective e-mail being sent to the student. Upon the third violation the user and faculty advisor will receive a corrective e-mail, and the fourth violation will result in expulsion from the labs and/or cleanroom. The period of expulsion will be decided by the Process and Equipment Manager and the Birck Director. More serious procedural violations will be handled at the discretion of the Process and Equipment Manager and the Birck Director.

4.3.3. Equipment Misuse Violations

If users are careless and don't follow procedures and break any equipment or contaminate it, their advisor will be charged for the staff time needed to re-train the student. We realize mistakes happen and this is part of the learning process, but repeated gross negligence will result in retraining charges. These retraining charges will be assessed when students misuse the equipment on a repeated basis after a written warning to the student and his/her advisor has been ignored. This affects all of the users of the facility and their productivity.

The approach described above is designed to promote a more collaborative working environment among the faculty, staff, and students, while at the same time ensuring a safe and effective research center for all users.

4.4. LABORATORY, NANOFABRICATION CLEANROOM, AND BIOCLEANROOM BILLING POLICIES

Any person, other than faculty and staff, who enters a laboratory at any time within a calendar month will be charged the monthly billing fee for that laboratory. Please note that sharing a badge or entry into a laboratory without a badge to avoid these charges constitutes theft, and will be dealt with accordingly.

Any person, other than faculty and staff, who enters the cleanroom or laboratory at any time within a calendar month will be charged the monthly billing fee for the cleanroom. This is regardless of whether there was one entry or many entries during that calendar month.

In addition to general entry charges which cover the cost of consumables and fixed costs within the laboratories, there are also equipment-usage fees.

Coral is the software suite used by the BNC to manage equipment reservations and billing within the facility. All users wishing to use equipment within the BNC must have a Coral login that charges to a valid One Purdue account number. Equipment must be enabled in Coral by the user controlling the equipment prior to use. Users are not to share login information.

To request a Coral login, the faculty advisor must fill out the form at:

<https://engineering.purdue.edu/NANO/coral>

Expired One Purdue charge accounts will be deactivated, thereby preventing a user from equipment use.

Each piece of equipment in the laboratory, the nanofabrication cleanroom or the biocleanroom has a logbook. Users must sign into the logbook and Coral before any work is started. Logbooks are to be filled out completely and legibly.

Off-campus users will be subject to an overhead fee of approximately 50%.

Users operating a piece of equipment without enabling in Coral and signing into the log book are subject to procedural violation restrictions per the previous discussion.

As a courtesy to other users, only make reservations you intend to use. Reserving time for another user is prohibited and will result in loss of equipment privileges.

Recharge billings are distributed monthly to faculty for approval. If the monthly billings go unapproved or unchallenged for a period of one month, payment will automatically be processed.

5. LABORATORIES PROCEDURES

SPECIFIC TO THE LABORATORIES ONLY

THE BIRCK NANOTECHNOLOGY CENTER CONTAINS GENERAL LABORATORIES AND BIOSAFETY LEVEL 2 (BSL 2) LABORATORIES. THERE ARE NO BIOSAFETY LEVEL 3 (BSL 3) LABORATORIES IN THE BNC.

5.1. GENERAL LABORATORY PROCEDURES (APPLY TO ALL LABORATORIES)

5.1.1. General Policies

Lab Training is required for unescorted access-- Badges must be worn at all times.

BNC Visitors must be escorted at all times. The host is responsible for visitor's behavior.

Doors must be closed and locked at all times. (DO NOT prop doors open.)

No eating, drinking, or chewing gum in research areas including the labs and support galleys.

All users must abide by the Glove Policy (see Section 5.1.4).

5.1.2. Clothing Requirements

Fully enclosed shoes must be worn in all laboratories. No open-toe or open-heel shoes are allowed.

Long pants or long skirt must be worn in all laboratories – no shorts are allowed.

Glasses must be worn in all laboratories. Safety glasses with side shields are strongly recommended

5.1.3. Labs Containing Compressed Gases

Glasses or safety glasses are required in laboratories where a compressed gas that discharges into the room (not into equipment) and/or a blow-off gun is used. Safety glasses with side shields are strongly recommended.

Requirements for “All Laboratories” (Section 5.1.1) also apply.

5.1.4. Glove Policy

Laboratory clean gloves (Blue): Must be worn in laboratories when working with the interior of equipment, handling contamination-sensitive parts, or other conditions where skin oils would be a problem. Blue gloves may NOT be used for handling chemicals (except solvent squirt bottles).

Laboratory chemical gloves (Orange): Should always be worn within hazardous zone at hood. Orange gloves should never worn outside of hazardous zone EXCEPT when transporting or handling chemicals

Biological gloves (Cream): Can ONLY be worn within BSL1-rated laboratories.

Black – Can ONLY be worn within BSL2-rated laboratories. No gloves allowed: On doorknobs/doorhandles, computers, telephones, or in offices.

“One-glove rule” is acceptable. This means that one hand is gloved for handling sample, while the other hand is not gloved, used for door knobs, etc.

5.1.5. Hood Hazard Zones

Fume Hood Hazard Zones are demarcated with red and yellow hazard tape in each Birck laboratory. Within these hazard zones, specific policies must be followed.

5.1.5.1 *Solvent Hood Hazardous Zone*

Requirements for “All Laboratories” apply (Section 5.1.1). Furthermore, solvent hood specific Personal Protective Equipment (PPE) is required in hazardous zone. PPE includes:

- Non-vented chemical-proof safety goggles
- Chemical-resistant coat-apron
- Chemical-resistant gloves

Users must adhere to the Buddy Policy (Section 5.1.7) to work in a solvent hood.

Note: The Hazardous Zone is marked with tape

5.1.5.2 *Acid Hood Hazardous Zone*

Requirements for “All Laboratories” apply (Section 5.1.1). Furthermore, acid hood specific Personal Protective Equipment (PPE) is required in hazardous zone. PPE includes:

- Non-vented chemical-proof safety goggles
- Chemical-resistant coat-apron
- Chemical-resistant gloves

When pouring chemicals in hazardous zone. PPE includes:

- All PPE required above
- Face shield

Users must adhere to the Buddy Policy (Section 5.1.7) to work in an acid hood.

NOTE: The Hazardous Zone is marked with tape.

5.1.6. Chemical Hazard Zones

5.1.6.1 *Chemical Squirt Bottles*

A limited number of chemicals are approved for use in squirt bottles, outside of chemical hoods.

Requirements for “All Laboratories” apply (Section 5.1.1). Furthermore, non-vented chemical proof safety goggles are required when handling squirt bottles outside of hood.

5.1.6.2 *Transporting Chemicals*

Requirements for “All Laboratories”, plus: Appropriate PPE (solvent or acid) while packing/unpacking chemicals.

All chemicals being transported outside of laboratories or within the cleanroom – including in the galleys – must be doubly contained in an approved safety overpack, or a spill-proof outer container.

No more than 1 gallon may be transported without use of a cart.

Goggles are required while transporting hazardous chemicals.

5.1.6.3 *Toxic Materials*

Requirements for “All Laboratories” apply, plus:

Cyanide and cyanide solutions MAY NOT be used in an acid hood or in proximity to acids! Lethal gases could be released.

When there is a potential for exposure to toxic materials – e.g., opening a chamber or process line – check with a staff member BEFORE proceeding. PPE according to the MSDS for the material must be used.

Read and understand the hazards of all materials that are being used in the lab!

Buddy Policy applies here (see Section 5.1.7).

5.1.7. Buddy Policy

When working with hazardous materials (see definition Section 3) you must have a second BNC user or lab buddy present:

You may work alone: During normal working hours: **7am-5pm Monday-Friday** excluding holidays and breaks, or when lab attendants are on duty in the building (nominal hours listed below, holidays and breaks excluded). Note that the lab attendants will circulate through the building during the following weekly hours:

Mon -Fri	5pm – 12midnight
Sat & Sun	noon – 12midnight

At all other times, you must have another authorized user in the same lab.

Changes and holiday exclusions to lab attendants’ hours will be posted on the website and/or in the building.

5.2. *BIOLABORATORIES*

The BNC Biolaboratories are classified as General Biological Laboratories - Biosafety Level 1 (BSL1) and Biosafety Level 2 (BSL 2) Laboratories. There are no BSL3 classified laboratories in the BNC.

All laboratory personnel and others whose work requires them to enter the laboratory must understand the biological and other hazards with which they will come in contact through their normal work in the laboratory, and be trained in appropriate safety precautions and procedures. Personnel must be required to know, understand, and follow standard practices and procedures. Training in laboratory safety must be provided and competence in safe technique demonstrated before work is allowed with hazardous agents or toxins.

5.2.1. General Biological Laboratories

Laboratories, 2077, and 2081 in the BNC are general biological laboratories. These laboratories are classified as BioSafety Level 1 (BSL1).

General biological laboratories are suitable for experiments involving agents of no known or minimally potential hazard to laboratory personnel and the environment. Appropriate PPE must be worn (lab coat optional) but work is generally conducted on open bench tops. Special containment equipment is not required or generally used.

BSL1 Training for General Biological Labs:

Laboratory personnel must have specific training in the procedures conducted in the laboratory and are supervised by a scientist with general training in microbiology or a related science. Mandatory training involves, (a) Online Biosafety training for Birck Labs (BNC-208) that must be taken and the online test must be passed, (b) REM online biosafety training that must also be taken and all tests must be passed, and (c) any other biosafety training required by the Primary Investigator and the Birck Biosafety Officer that must be completed. The following standard and special practices apply to agents assigned to general biological laboratories.

5.2.1.1 *Standard Microbiological Practices*

1. Laboratory doors are kept closed when experiments are in progress.
2. Work surfaces are decontaminated daily and after any spill of biohazardous material.
3. All contaminated liquid or solid wastes are decontaminated before being disposed of or otherwise handled.
4. Mechanical pipetting devices are used; mouth pipetting is prohibited.
5. Eating, drinking, smoking, storing of food, and applying cosmetics are not permitted in the work area.
6. Persons wash their hands after they handle biohazardous materials and when they leave the laboratory.
7. All procedures must be carefully performed to minimize the creation of aerosols.

5.2.1.2 *Personal Protective Equipment and Laboratory Gowning (clothing) Requirements for BSL-1*

1. The wearing of laboratory coats is recommended.
2. Gloves are required.
3. Do not touch door knobs or telephones with gloved hands.
4. Before leaving laboratory, remove and discard gloves, and wash hands.

5.2.1.3 *Special Practices*

Contaminated Materials: Contaminated materials that are to be decontaminated (autoclaved) at a site away from the laboratory are placed in an orange biohazard bag that in turn is placed inside a durable leak-proof container. In the Birck BSL2 labs these containers are white trash cans lined with the orange plastic biohazard bags. All

contaminated solid waste should be placed in these containers and kept covered. BNC Staff will enter the lab weekly to transfer this waste to the large orange disposal cans located in the galley next to the lab doors. Separate biohazardous trash containers are available for liquid waste while red sharps containers are for the containment of contaminated sharps and glass in the BNC Biolaboratories.

Contaminated red sharps boxes will be autoclaved in Bindley Bioscience Center, Room 233, after they are transported in the above trash cans. BNC staff in charge of this process will make sure that autoclaving is performed successfully. Decontaminated bags are removed from the autoclave and properly disposed of to await REM pickup in a biohazard cardboard box. When the box is full, the box is taped up and a REM Biohazardous Waste Pickup form is filled in and attached to the top of the box. REM is notified by phone in advance so that REM can dispose of this decontaminated trash as soon as possible.

5.2.1.4 *Containment Equipment*

Special containment equipment is generally not required for manipulations of agents assigned to general biological laboratories.

5.2.2. Biosafety Level 2 (BSL 2) Laboratories

Laboratories 2043 and 2087 in the BNC are BSL2 laboratories.

Biosafety Level 2 laboratories are similar to general biological laboratories and are suitable for work involving agents that represent a moderate hazard for personnel. The environment of Biosafety Level 2 laboratories differs from BSL1 laboratories in that:

1. BSL2 Laboratory personnel have specific training in handling pathogenic agents and are directed by the principle investigator. Online Biosafety training for Birck Labs must be taken and the online test must be passed. REM online biosafety training must be taken and tests must be passed. Personnel must be properly trained in the use of biological safety cabinets. Personnel will be trained for proper biological waste management.
2. Access to the BSL2 laboratories is limited when work is being conducted, and is restricted to trained users only, when hazardous materials are in use.
3. All BSL2 laboratory users are responsible for knowing the appropriate procedures contained in the Purdue Biological Safety Manual, found at this link: <http://www.purdue.edu/rem/home/booklets/bioman.pdf>.
4. Certain procedures in which biohazardous aerosols are created need to be conducted in biological safety cabinets or other physical containment equipment.
5. The following standard and special practices, safety equipment, and facilities apply to agents assigned to Biosafety Level 2:

5.2.2.1 *Standard Microbiological Practices*

1. Access to the BSL 2 laboratory is limited or restricted by the supervisor when work with biohazardous agents is in progress. Laboratory doors are kept closed at all times.

2. Work surfaces are decontaminated at least once a day and after any spill of biohazardous material.
3. All contaminated liquid or solid waste is decontaminated before disposal.
4. Mechanical pipetting devices are used; mouth pipetting is prohibited.
5. Eating, drinking, smoking, chewing gum or tobacco, and applying cosmetics are not permitted in the laboratory.
6. Persons wash their hands when first entering the lab, after handling biohazardous agents, and when leaving the laboratory.
7. All procedures are performed carefully to minimize the creation of aerosols.
8. Serological procedures with inactivated antigens known or shown to be free of residual infectivity can be performed on the open bench.
9. Bench top work is done on absorbent paper, which is disposed of using approved biological waste procedures. (See Section 5.2.2.3)

5.2.2.2 *Personal Protective Equipment and Laboratory Gowning (clothing) Requirements for BSL-2*

1. Requirements for “All Laboratories” (Section 5.1.1.).
 2. Specially marked lab coats are required in the BSL 2 laboratory. Laboratory clothing or gloves must not be worn in non-laboratory areas.
 3. No shorts, sandals, or open-toed shoes are allowed in the laboratories.
 4. Surgical mask must be worn for aerosol protection when working with infectious agents.
 5. Birck-designated biological gloves are required.
-
6. Laboratory clothing or gloves must not be worn in non-laboratory areas.

5.2.2.3 *Special Practices*

1. Contaminated materials that are to be decontaminated or autoclaved away from the BSL2 laboratory are placed in an orange biohazard bag which is then placed inside a durable, leak-proof container, which is closed before being removed from the laboratory. This outer container must be a water-impervious biohazard container with a biohazard label clearly visible on it.
2. Access to the BSL2 laboratory is limited by the laboratory supervisor when experiments are being conducted. In general, persons who are at increased risk of acquiring infection or for whom infection may be unusually hazardous are not allowed in the BSL2 laboratory or animal rooms. Persons at increased risk may include children, pregnant women, and individuals who are immunodeficient or immunosuppressed. The supervisor has the final responsibility for assessing each individual circumstance and determining who may enter or work in the area.
3. The Birck Biosafety Officer will assure that only persons who have been advised of the potential hazard and who meet any specific entry requirements (e.g. immunizations) enter the BSL2 laboratories.

4. When biohazardous materials are present in the laboratory, a biohazard warning sign incorporating the universal biohazard symbol is posted on all laboratory access doors and on such other items (i.e. equipment, containers, and materials) as appropriate to indicate the presence of biohazardous agents. The hazard warning sign should list the name of the laboratory supervisor or other responsible person(s), and indicate any special requirements for entering the area (immunization, respirators, etc.).
5. An insect and rodent control program is in effect.
6. All wastes from laboratories must be appropriately decontaminated before being disposed.
7. If activities of lesser biohazard potential are conducted in the laboratory concurrently with activities requiring Biosafety Level 2, all activities will be conducted at Biosafety Level 2.
8. Gloves will be worn for all procedures requiring the handling of biohazardous materials.
9. Serological procedures with inactivated antigens shown to be free of residual infectivity can be performed on the open bench.
10. All spills, accidents, and overt or potential exposures to biohazardous materials must be immediately reported to the laboratory supervisor. A written record must be prepared and maintained. Appropriate medical evaluation, surveillance, and treatment must be provided.
11. Serum specimens may be collected periodically depending on the agents handled or the function of the facility.
12. A safety or operations manual which identifies known and potential hazards and which specifies practices and procedures to minimize or eliminate such risks should be prepared or adopted. Personnel should be advised of special hazards and are required to follow standard practices and procedures.

5.2.2.4 *Containment equipment*

Biological safety cabinets (Class II) or other appropriate personal protective or physical containment devices are used whenever:

1. Procedures with a high potential for creating biohazardous aerosols are conducted. These may include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, and opening containers of biohazardous materials whose internal pressures may be different from ambient pressures, and procedures using animal derived tissue samples.
2. High concentrations or large volumes of biohazardous agents are used. Such materials may be centrifuged in the open laboratory if sealed heads or centrifuge safety cups are used and if they are opened only in a biological safety cabinet.

5.2.3. Material Transport and Handling

Transport carts are never to be used inside BSL 2 laboratories. Contaminated materials leaving the labs must be double bagged and carried on carts kept outside the laboratories.

Specific PPE (BSL1 or BSL2), including safety glasses, must be worn while packing/unpacking samples. Seal all BSL1 and/or BSL-2 samples with an appropriate cap or lid and Parafilm to prevent spillage. All samples must be placed inside a

secondary container that is not breakable (e.g. styrofoam box). Anything over 5 lbs. should be transported via a lab cart. All secondary containers will be marked with a biohazard label stating whether the sample is BSL1 or BSL2. Once sealed, samples will not be opened en route to BSL1 or BSL2 labs.

5.3. LASER LABORATORIES

When using a class 3b or 4 lasers, the foremost concern is the danger posed to one's eyes and exposed skin. Depending on the wavelength and the power output of the laser light as well as the exposure duration, the cornea, lens, or retina may be injured. Irreparable damage to parts of the eye, and permanent partial or full loss of vision are possible.

Accidental exposure to laser light can be minimized by following the standard operation procedures of the laser system, using correct approved laser safety eyewear. Requirements for "All Laboratories" apply here (see Section 5.1.1). Wavelength specific laser safety goggles are required.

Radiation safety signs must be clearly posted and laser safety curtains must be installed around laser.

Individuals are authorized to use class 3b and 4 lasers upon receiving laser safety training, demonstrating competency, and submitting complete application forms. Contact REM to learn more about Purdue's laser safety and training program.

All laser documentation must be listed with REM

5.4. HIGH VOLTAGE / X-RAY LABORATORIES

Baseline monitoring of equipment must be done upon installation. This must be followed by semi-annual check of X-Ray levels. Furthermore, individuals are authorized to use BNC X-Ray Diffraction equipment upon completion of radiation safety training, demonstration of competency, and submitting completed forms. Contact REM to learn more about Purdue's radiation safety and training program.

Do not remove or modify existing safety measures on all high voltage and/or x-ray equipment. If any modification is necessary, appropriate supervision and re-monitoring is required. Parties that must be notified include:

- Safety Manager
- Building Manager
- REM

5.5. LABORATORY AREAS WITH ROTATING EQUIPMENT

Requirements for "All Laboratories" apply (Section 5.1.1) as well as glasses or safety glasses. Safety glasses with side shields are strongly recommended.

Loose clothing such as neckties, etc., are to be secured. Long hair must be secured or covered.

5.6. LABORATORY SERVICE GALLEYS

General Laboratory Policies must be followed in galleys (Section 5.1).

Guidelines for areas with rotating equipment apply (Section 5.5)

6. NANOFABRICATION CLEANROOM PROCEDURES *SPECIFIC TO THE NANOFABRICATION CLEANROOM ONLY*

6.1. CLOTHING REQUIREMENTS

Glasses must be worn at all times in the cleanroom. Safety glasses with side shields are strongly recommended

6.2. NANOFABRICATION CLEANROOM ACCESS

6.2.1. Training Documentation

No one will be allowed access to the BNC Nanofabrication cleanroom until they have submitted documentation to the BNC Safety Coordinator certifying that they have received proper safety training, nanofabrication cleanroom training and certification (if applicable). Appropriate safety guidelines issued by, but not limited to, the BNC, Purdue CHP (Chemical Hygiene Plan), OSHA (Occupational Safety and Health Administration), and NFPA (National Fire Protection Association) will be followed. See Section 2.3 Nanofabrication Cleanroom Entry and Section 4.2 Safety Training Documentation.

6.3. GOWNING PROCEDURE

6.3.1. Pregowning

Hair Cover

Bouffant cap of spun-bonded polyolefin with elastic closure. Cap must be large enough to contain all hair and elastic must allow snug fit on head. Use care to ensure that all loose hair is contained within the cap.

Shoe Cover

Shoe cover of spun-bonded polyolefin with elastic closure at top. Shoe cover must provide good traction on cleanroom flooring surfaces.

6.3.2. Gowning

Hood

Open-face hood with two snap adjustments on crown and one snap adjustment on rear, with double two-snap closure at neck and two interior snaps per side for veil attachment. Fabric is Burlington C-4 or equivalent.

Face veil

Disposable Kimberly-Clark Ranger, or equivalent, snap-in veil. Veil is worn inside the hood.

Jumpsuit

Full jumpsuit with front zipper and military collar, knitted cuffs on sleeves and snapped cuffs on leg. A snap or loop at the collar of the jumpsuit for hood attachment when not in use is also required. Fabric is Burlington C-4 or equivalent. Cuff material is antistatic knitted material suitable for Class 10 cleanroom use.

Boot

Conductive-molded-sole boot with fabric upper. Four adjustment snaps at top, and possibly vertically arranged snaps for attachment to jumpsuit leg. Sole material is “Aussie” sole, ChemStat 939E Plus, or equivalent. Fabric to be Burlington C-4 or equivalent.

6.3.3. Pregowning Procedure

In the pregowning area, select a pair of shoe covers. Sit on the step-over bench, and lift one leg off the floor. Place the shoe cover over your shoe, and then rotate that foot to the clean side of the bench. Place foot on clean-side floor. Lift other foot and repeat the procedure, moving foot across bench *after* the shoe cover has been put on.

On the clean side of the step-over bench, select a hair cover. Put on the hair cover making sure that all hair is contained inside the cover. It is suggested that the hair cover not cover your ears to make it easier to hear while in the nanofabrication cleanroom.

Swipe your nanofabrication cleanroom access badge through the card reader and enter the air shower. You may not allow anyone else to enter the cleanroom air shower with your card swipe. The air shower will begin automatically. When the cycle is finished, enter the gowning room.

No one may enter the gowning room for any reason without following the pregowning procedures.

6.3.4. Gowning Procedure – Fresh Garment

Enter the gowning room and select a nanofabrication cleanroom hood, face veil, jumpsuit, and boots. Take them to a gowning station to begin the gowning process.

Snap the face veil inside the hood, and pull hood over your head. Use care to ensure that all hair remains inside the hair cover while putting on the hood. Snap the appropriate neck snaps of the hood. Adjust the hood using the adjustment snaps on the top of the hood and the rear of the hood to ensure a snug, comfortable fit. Press the wire in the face veil over the bridge of the nose to ensure a snug fit.

Put on the nanofabrication cleanroom jumpsuit without allowing any portion of the jumpsuit to touch the floor. The recommended procedure is to gather the arm and leg cuffs at the bottom of the zipper of the jumpsuit. Be seated on the gowning bench, and place one leg into the leg of the jumpsuit while releasing that leg from the zipper bottom. Pull the jumpsuit on that leg such that it completely clears the shoe cover. Repeat this procedure for the second leg.

Holding the sleeves of the jumpsuit at the bottom of the zipper, arise and pull the waist of the jumpsuit to your waist. Put one arm into the appropriate arm of the jumpsuit while releasing that cuff. Repeat with the second arm and pull the upper part of the jumpsuit into place.

Adjust the jumpsuit such that it is comfortable, and zip the front of the jumpsuit to the top of the zipper.

Be seated on the nanofabrication cleanroom bench and put on the nanofabrication cleanroom boots, ensuring that the upper of the boot does not touch the nanofabrication cleanroom floor. Adjust the fit of the boots with the buckles, and snap the boot snap to the snap on the calf of the jumpsuit. Snap the boot cuff to provide a snug, comfortable fit.

Proceed to the gowning room mirror, and adjust the fit of your nanofabrication cleanroom garments. Put on your nanofabrication cleanroom gloves such that you only touch the cuff of the glove. Adjust the fit of your gloves with both hands gloved, then put on your safety glasses.

Proceed to the nanofabrication cleanroom air shower and enter. The shower will begin automatically. Hold arms up vertically and rotate three times in the air shower to effectively allow the air pressure to cleanse the exterior of your cleanroom garments. When the cycle is complete, enter the nanofabrication cleanroom.

6.3.5. Gowning Procedure – Previously Worn Garment

Enter the gowning room and proceed to your gowning station.

Users are responsible for rotating their used cleanroom garments. After approximately five uses, all cleanroom garments (including hoods, jumpsuits, and boots) should be deposited in the designated receptacles for laundering. After setting your cleanroom garments aside for laundering, obtain fresh garments and follow the instructions in Section 6.3.4 “Gowning Procedure – Fresh Garment”. When gowning with previously worn garments, remove the nanofabrication cleanroom hood from the station and, at your option, replace the face veil or continue to use the existing face veil.

Use care to ensure that all hair remains inside the hair cover while putting on the hood. Snap the appropriate neck snaps of the hood. Adjust the hood using the adjustment snaps on the top of the hood and the rear of the hood to ensure a snug, comfortable fit. Press the wire in the face veil over the bridge of the nose to ensure a snug fit.

Put on the nanofabrication cleanroom jumpsuit without allowing any portion of the jumpsuit to touch the floor. The recommended procedure is to gather the arm and leg cuffs at the bottom of the zipper of the jumpsuit. Be seated on the gowning bench, and place one leg into the leg of the jumpsuit while releasing that leg from the zipper bottom. Pull the jumpsuit on that leg such that it completely clears the shoe cover. Repeat this procedure for the second leg.

Holding the sleeves of the jumpsuit at the bottom of the zipper, arise and pull the waist of the jumpsuit to your waist. Put one arm into the appropriate arm of the jumpsuit while releasing that cuff. Repeat with the second arm and pull the upper part of the jumpsuit into place.

Adjust the jumpsuit such that it is comfortable, and zip the front of the jumpsuit to the top of the zipper.

Be seated on the nanofabrication cleanroom bench and put on the nanofabrication cleanroom boots, ensuring that the upper of the boot does not touch the nanofabrication cleanroom floor. Adjust the fit of the boots with the buckles, and snap the boot snap to

the snap on the calf of the jumpsuit. Snap the boot cuff to provide a snug, comfortable fit.

Proceed to the gowning room mirror, and adjust the fit of your nanofabrication cleanroom garments. Put on your nanofabrication cleanroom gloves such that you only touch the cuff of the glove. Adjust the fit of your gloves with both hands gloved, then put on your safety glasses.

Proceed to the nanofabrication cleanroom air shower and enter. The shower will begin automatically. Hold arms up vertically and rotate three times in the air shower to effectively allow the air pressure to cleanse the exterior of your cleanroom garments. When the cycle is complete, enter the nanofabrication cleanroom.

6.4. *DEGOWNING PROCEDURE*

The degowning procedure is essentially the reverse of the gowning procedure.

On exiting the nanofabrication cleanroom, discard nanofabrication cleanroom gloves in the trash container in the gowning room. Remove your safety glasses if you do not wear them outside the nanofabrication cleanroom. Proceed to your gowning station.

Sitting on the gowning bench, remove nanofabrication cleanroom boots and place in their designated location.

Remove nanofabrication cleanroom jumpsuit by unzipping the front of the garment, and removing the hands and arms from the sleeves of the jumpsuit. Gather the sleeve cuffs at the bottom of the zipper, and pull the jumpsuit well down below the waist. Sit on the gowning bench, and remove one leg from the jumpsuit, ensuring that the jumpsuit does not touch the floor. Gather the now-free leg of the jumpsuit with the arm cuffs, and repeat the procedure for the second leg.

Stand up, and grasp the jumpsuit only by the collar, allowing the jumpsuit to hang free. Place jumpsuit on hanger, again taking care not to allow it to touch the floor. Hang the hanger on the garment rack.

Remove the nanofabrication cleanroom hood, and snap the hood to the snap at the neck of the jumpsuit.

Exit the gowning room and enter the pregowning area. Remove the bouffant cap and discard. Be seated on the pregowning bench, and rotate one leg over the bench. Remove the shoe cover and step down onto the floor. Rotate the second leg over the bench, and then remove that shoe cover. Discard the shoe covers or store them in your assigned shoe cover bin and exit the pregowning area.

6.5. *MATERIAL ENTRY PROCEDURE*

There are three routes by which material can enter the cleanroom. The preferred route for small items – less than 2'x2'x2' – is the dumbwaiter in the subfab. The second route for small items is through the gowning room. The route for larger items is through the equipment/material- entry room on the west side of the cleanroom (blowdown room).

Material entering through the dumbwaiter that is doubly bagged has the outer bag removed at the dumbwaiter; the item is then placed into the dumbwaiter and elevated to the cleanroom level. In the cleanroom, the inner bag is removed.

For material that is entering through the dumbwaiter that is singly bagged, the bag is to be wiped with 10% IPA: water solution with a cleanroom wiper prior to being placed in the dumbwaiter, it is elevated to the cleanroom level, and the bag is removed in the cleanroom.

Material entering through the dumbwaiter that is not bagged is wiped with 10% IPA: water solution BOTH before entering the dumbwaiter and on exit from the dumbwaiter in the cleanroom.

Similarly, items entering through the gowning room or equipment/material-entry room are to have the outer bag removed (or cleaned if no outer bag) on entry of the equipment/material-entry room and the inner bag removed (or cleaned if no inner bag) immediately on entry of the cleanroom.

In all cases, removal of the outer bag (or initial cleaning) is performed by a person in street clothing while removal of the inner bag (or final cleaning) is performed by a person wearing a cleanroom garment.

6.6. *EQUIPMENT MAINTENANCE PROCEDURES*

Equipment maintenance within the cleanroom requires careful procedures to ensure that: 1) No contamination of the cleanroom occurs; 2) No unforeseen interruption of utilities to other cleanroom equipment takes place; 3) The equipment being maintained is returned to service in a clean condition. Refer to the BNC Nanofabrication Cleanroom Maintenance Manual for procedural details.

6.7. *HOUSEKEEPING PROCEDURES*

Housekeeping procedures must insure that no contamination to the cleanroom occurs. All housekeeping procedures must comply with all instructions found in the BNC Housekeeping Manual.

6.8. *CLEANROOM EVACUATION POLICY*

In case of an emergency, including the activation of any and all building alarms, evacuate the cleanroom immediately via the nearest exit. There is no need to return to the gowning room and/or remove any cleanroom garments. Every bay and chase in the nanofabrication cleanroom contains an emergency exit door. Upon exiting the cleanroom, proceed immediately to the SW corner of Burton Morgan and check-in with a staff member. Upon reaching the Burton Morgan meeting site, you may pause to remove your cleanroom garment. Once an all clear is given by a uniformed officer, return your garment for laundering.

6.9. *NEW PROCESS APPROVAL & PROCESS/EQUIPMENT ISSUES*

Prior to starting a process in the cleanroom, students will present a 15 minute summary of their proposed research to key staff members. The Process and Equipment Manager will

lead this activity and appoint the staff members who will participate in this review process. Also, as process problems arise, please contact the Process and Equipment Manager directly via e-mail or in person to discuss the problem. The engineering staff will be happy to assist you in solving the problem and/or providing alternative solutions. An on-line forum also exists where process and equipment questions can be addressed to the staff. This forum, called “Ask the Staff,” is located here:
<https://engineering.purdue.edu/Intranet/Groups/BNC/AsktheStaff>

7. BIOCLEANROOM PROCEDURES SPECIFIC TO THE BIOCLEANROOM ONLY

7.1. BIOCLEANROOM ACCESS

7.1.1. Training Documentation

No one will be allowed access to the BNC Biocleanroom until they have submitted documentation to the BNC Safety Coordinator certifying that they have received proper safety training, biocleanroom training and certification (if applicable). Appropriate safety guidelines issued by, but not limited to, the BNC, Purdue CHP, OSHA, and NFPA will be followed. See Section 2.3 Cleanroom Entry and Section 4.1.2 Safety Training Documentation

7.2. BIOCLEANROOM GOWNING PROCEDURE

7.2.1. Cleanroom Garments for the Biocleanroom

7.2.1.1 Hair Cover

Bouffant cap of spunbonded polyolefin with elastic closure. Cap must be large enough to contain all hair and elastic must allow snug fit on head.

7.2.1.2 Hood

Open-face hood with two interior snaps per side for veil attachment. Material to be coated Tyvek, such as Baxter Advantage.

7.2.1.3 Face veil

Disposable Kimberly-Clark Ranger snap-in veil.

7.2.1.4 Jumpsuit

Full jumpsuit with front zipper and military collar, elastic cuffs on sleeves and snapped cuffs on leg, with boot snap at mid-calf. Material to be coated Tyvek, such as Baxter Advantage.

7.2.1.5 Boot

Conductive-sole boot with coated-Tyvek upper. Elastic top and three vertically arranged snaps for attachment to jumpsuit leg. Sole material must provide good traction on cleanroom flooring.

7.2.2. Gowning Procedure

Swipe your biocleanroom access badge through the card reader and enter the air shower. You may not allow anyone else to enter the air shower with your card swipe. The air shower will begin automatically. When the cycle is finished, enter the gowning room.

Put on the hair cover making sure that all hair is contained inside the cover. It is suggested that the hair cover not cover your ears to make it easier to hear while in the biocleanroom.

Select a biocleanroom hood, face veil, jumpsuit, and boots. Take them to a gowning station to begin the gowning process.

Snap the face veil inside the hood, and pull hood over your head. Use care to ensure that all hair remains inside the hair cover while putting on the hood. Press the wire in the face veil over the bridge of the nose to ensure a snug fit.

Put on the biocleanroom jumpsuit without allowing any portion of the jumpsuit to touch the floor. The recommended procedure is to gather the arm and leg cuffs at the bottom of the zipper of the jumpsuit. Be seated on the gowning bench, and place one leg into the leg of the jumpsuit while releasing that leg from the zipper bottom. Pull the jumpsuit on that leg such that it completely clears the shoe cover. Repeat this procedure for the second leg.

Holding the sleeves of the jumpsuit at the bottom of the zipper, arise and pull the waist of the jumpsuit to your waist. Put one arm into the appropriate arm of the jumpsuit while releasing that cuff. Repeat with the second arm and pull the upper part of the jumpsuit into place.

Adjust the jumpsuit such that it is comfortable, and zip the front of the jumpsuit to the top of the zipper.

Be seated on the biocleanroom bench and put on the biocleanroom boots, ensuring that the upper of the boot does not touch the biocleanroom floor. Snap the boot cuff to provide a snug, comfortable fit.

Proceed to the gowning room mirror, and adjust the fit of your biocleanroom garments. Put on your biocleanroom gloves such that you only touch the cuff of the glove. Adjust the fit of your gloves with both hands gloved, then put on your safety glasses.

Proceed to the biocleanroom air shower and enter. The shower will begin automatically. When the cycle is complete, enter the biocleanroom.

7.3. *BIOCLEANROOM DEGOWNING PROCEDURE*

On exiting the biocleanroom, discard biocleanroom gloves, boots, jumpsuit, hood, and bouffant cap in the trash container in the degowning corridor. Remove your safety glasses if you do not wear them outside the biocleanroom.

7.4. *BIOCLEANROOM MATERIAL ENTRY PROCEDURE*

7.5. *BIOCLEANROOM EQUIPMENT MAINTENANCE PROCEDURES*

7.6. *BIOCLEANROOM HOUSEKEEPING PROCEDURES*

APPENDIXES

1. BNC CHEMICALS

▪ Common BNC Chemicals

AQUEOUS Acids/Bases	SOLVENTS	LITHOGRAPHY
Acetic Acid	Acetone	Buffered oxide etch 6:1
Hydrochloric Acid	2-propanol	Hexamethyldisilazane (HMDS)
Hydrofluoric Acid (49%)	Methanol	Tetramethyldisilazane (TMDS)
Nitric Acid	Toluene	AZ Developer
Phosphoric Acid	Xylene	AZ Developer 400
Sulfuric Acid	Cholorobenzene	AZ Developer 351
Ammonium Hydroxide		
Hydrogen Peroxide (30%)		

2. TRAINING CHECKLIST

- Online Visitor Orientation
- New BNC Graduate Students
- New BNC PostDocs
- Visiting Scientists

3. EXAMPLES OF HAZARDOUS CHEMICALS

Acids: Sulfuric Acid (H_2SO_4), Hydrofluoric Acid (HF), Acetic Acid (HOAc), Phosphoric Acid (H_2PO_4)

Caustics (Bases): Sodium Hydroxide (NaOH), Potassium Hydroxide (KOH)

Solvents: Isopropyl Alcohol (2-propanol or IPA), Ethanol (Ethyl Alcohol or EtOH), Acetone, Methyl Ethyl Ketone (MEK)

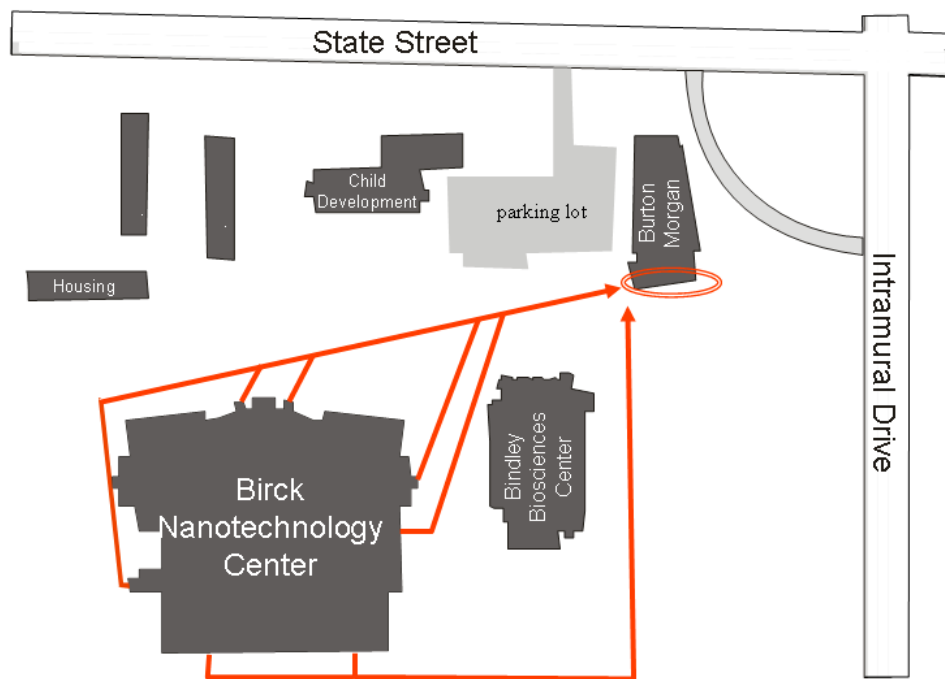
Oxidizers: Hydrogen Peroxide (H_2O_2)

4. RELEVANT WEBSITES

- Birck Nanotechnology Center
<http://www.nano.purdue.edu>
- SSLAB
<http://www.ecn.purdue.edu/SSLAB/>
- Birck Training
<http://www2.itap.purdue.edu/bnc/training/>
- Chemical Orders
<https://engineering.purdue.edu/NANO/ChemMgmt>
- REM
<http://www.purdue.edu/rem/>
- CDC
<http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4toc.htm>
- Purdue Emergency Procedures Handbook

<http://www.purdue.edu/physicalfacilities/emergencycontacts.php>

5. EVACUATION MEETING POINT



6. SUPPLEMENTAL EVACUATION GUIDELINES FOR PEOPLE WITH DISABILITIES

The following guidelines have been adopted by Purdue University to assist in planning for the evacuation of people with physical disabilities.

In All Emergencies, After an Evacuation has been Ordered:

- Evacuate if possible.
- **DO NOT** use elevators, unless authorized to do so by emergency services personnel.
- **If you have a Physical Disability and are Unable to Use Stairways:**
 - Stay calm, and take steps to protect yourself.
 - If there is a working phone, call 911 and tell the police dispatcher where you are or where you will be moving to.
 - If you must move, we recommend the following:
 - a) Move to an enclosed exit stairway.
 - b) Request persons exiting by way of the stairway to notify the Fire Department of your location.
 - c) As soon as practical, move onto the stairway and await fire department personnel. If the situation is life threatening, call 911 from campus telephone or 911 from a pay telephone.
- Check on people with special needs during an evacuation. A “buddy system”, where people with disabilities arrange for volunteers (co-workers/neighbors) to alert them and assist them in an emergency, is recommended.
- **Only** attempt an emergency evacuation if you have had emergency assistance training **or** the person is in immediate danger and cannot wait for emergency services personnel.
- ALWAYS ASK someone with a disability how you can help **before** attempting any emergency evacuation assistance. Ask how he or she can best be assisted or moved, and whether there are any special considerations or items that need to come with the person.

6.1 Blindness or Visual Impairment

- Provide verbal instructions to advise of the safest route or direction using simple directions, estimated distances, and directional terms.
- DO NOT grasp a visually impaired person’s arm. Ask if he or she would like to hold onto your arm as you exit, especially if there is debris or a crowd.
- Give other verbal instructions or information (i.e. elevators cannot be used).

6.2 Deafness or Hearing Loss

- Get the attention of a person with a hearing disability by touch and eye contact. Clearly state the problem. Gestures and pointing are helpful, but be prepared to write a brief statement if the person does not seem to understand.
- Offer visual instructions to advise of safest route or direction by pointing toward exits or evacuation maps.

6.3 Mobility Impairment

- It may be necessary to help clear the exit route of debris (if possible).

- If people with mobility impairments cannot exit, they should move to a safer area, e.g.
 - most enclosed stairwells
 - an office with the door shut which is a good distance from the hazard (and away from falling debris in the case of earthquakes)
- Call 911 or notify police or fire personnel immediately about any people remaining in the building and their locations.
- Police or fire personnel will decide whether people are safe where they are, and will evacuate them as necessary. The Fire Department may determine that it is safe to override the rule against using elevators.
- If people are in immediate danger and cannot be moved to a safer area to wait for assistance, it may be necessary to evacuate them using an evacuation chair or a carry technique.

Power Outages:

- If an outage occurs during the day and people with disabilities choose to wait in the building for electricity to be restored, they can move near a window where there is natural light and access to a working telephone. During regular business hours, Building Deputies should be notified so they can advise emergency personnel.
- If people would like to leave and an evacuation has been ordered, or if the outage occurs at night, call 911 and request evacuation assistance.

The following guidelines are general and may not apply in every circumstance.

- Occupants should be invited to volunteer ahead of time to assist people with disabilities in an emergency. If a volunteer is not available, designate someone to assist who is willing to accept the responsibility.
- Volunteers can obtain emergency evacuation information regarding lifting techniques from the Affirmative Action Office.
- Two or more trained volunteers, if available, should conduct the evacuation.
- Try to avoid evacuating people with disabilities in their wheelchairs. This is standard practice to ensure the safety of people with disabilities and volunteers. Wheelchairs will be evacuated later if possible.
- **ALWAYS ASK** people with disabilities how you can help **before** attempting any emergency evacuation assistance. Ask how they can best be assisted or moved, and if there are any special considerations or items that need to come with them.
- Proper lifting techniques (e.g. bending the knees, keeping the back straight, holding the person close before lifting, and using leg muscles to lift) should be used to avoid injury to rescuer's backs.
- Certain lifts may need to be modified, depending on the disabilities of the people.

Summary

Prepare occupants in your building ahead of time for emergency evacuations. Know your building occupants. Train staff, faculty, and students to be aware of the needs of people with disabilities and to know how to offer assistance. Hold evacuation drills in which occupants participate, and evaluate drills to identify areas that need improvement. Plans must cover regular working hours, after hours, and weekends. Everyone needs to take responsibility for preparing for emergencies. People with disabilities should consider what they would do and whether they need to take additional steps to prepare.

Revision Log

Date	Document Owner	Change Owner	Description of Changes
9-1-05	J. R. Weaver	J. R. Weaver	Initial Release of Document
10-13-05	J. R. Weaver	J. R. Weaver	Added clothing requirements to Cleanroom and Laboratory, Sections 5.1 and 6.1. Personal Protective Equipment Policy clarified, Section 4.2.
09-2006	J. Monahan-Dian	J. Monahan-Dian	Standardize formatting Update numbering & TOC Elaborate/Clarify the following sections: 2.31, 3.4, 4.1, 4.2.2, 4.2.1, 4.2.7, 4.3.1, 5.1, 5.2.1.3, 5.6, 6.8, appendix additions Insert Maps Insert August 1 2006 Policy Changes Include comments from LR & JW
09-2007	J. Monahan	J. Monahan	Training Links, Coral Instructions 4.2.8, Violations 4.1 & 4.3
12-2008	R. Reger	R. Reger	Major Update
03-2009	R. Reger	R. Reger	Note regarding retraining requirements, Sections 2.2.1 and 2.3.
003-2012	R. Reger	R. Reger	General update based on new Director policies