

Collider-Accelerator Department  
(C-AD)

# NASA Space Radiation Lab (NSRL)

## User Training

**Radiation Safety**  
**Conventional Safety**  
**Access Control**

## INFORMATION GUIDE



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# NSRL User Training

Radiobiology and Physics experiments are carried out at the Brookhaven National Laboratory (BNL) NASA Space Radiation Lab (NSRL), Bldg 958. This NSRL User Training is required for unescorted access to the NSRL target room. It is also typically required for unescorted access to building Bldg 958 even if you are not entering the target room (escorted access may be arranged).

The NSRL target room is an example of a Primary Area. A Primary Area is an area where beam travels. Primary Areas include target rooms and transfer lines (where the beam is enclosed in a tube-like enclosure known as beam pipe or vacuum pipe). Primary Areas are fully surrounded by radiation shielding. The areas have interlocked access gates (or doors) to prevent unauthorized entry, and to prevent entry with beam on. *Primary Areas are to be considered lethal with beam on.* With beam off, it is required that you have facility-specific knowledge for entry.

A pre-requisite for this course is BNL Radiological Worker-1 (RW-1) training. The retrain period for both RW-1 and this NSRL User Training is two years. *RW-1 and NSRL User Training are the minimum training requirements for unescorted access into the target room at NSRL.* After you complete RW-1 and NSRL User Training for the first time, convenient on-line challenge exams are available to re-qualify every two years.

This course covers:

- Physical design features and administrative controls that are used to prevent accidental radiation exposure in experimental areas
- Conventional safety issues
- Certain learning objectives from BNL's Benchtop Dispersibles Training. You would also need to complete a follow-up training demonstration if you will be working with dispersible radioactive material. The qualification would be valid only for limited dispersibles work within designated areas at NSRL Bldg 958 and at Medical Bldg 490, and not for other BNL locations.

The C-A Department recognizes the high level of work ethics demonstrated consistently over the years by the NSRL Users that visit our facility. The following is not meant to diminish our appreciation for that in any way. It is meant to help remind us all of possible consequences of non-compliances:

Please follow safety, environmental and animal care federal regulations and BNL requirements. NSRL is a U.S. Department of Energy (DOE) facility. It is important that you as a visiting User understand the significance of following safety, environmental and animal care federal regulations and BNL requirements. Non-compliances result in costly and disruptive investigations and BNL must file formal reports with the DOE. DOE facilities have been shut down for extended periods pending the outcome of such investigations. This is disruptive to the entire User community. A noncompliance by you here at BNL can also adversely affect your relationship with your home institution and can adversely affect your home institution's relationship with BNL. This is particularly the case for willful violations.

When signing documents such as User Agreements, a User is essentially confirming that he or she will do their assigned work according to the rules. The signature does not mean the individual is guaranteeing the work will be carried out perfectly or that there is no potential for a violation. It does mean that the individual is performing his or her duties to the best of their ability and has made a good faith effort to comply with the rules. A "good faith effort to comply" means that the User has familiarized him or her-self with the requirements that fall within his or her area of responsibility.

In addition to RW-1 and this NSRL User Training, other training may be required for you depending on your work activities. Examples of additional training include:

Web-based:

Lab Standard  
Hazardous Waste Generator  
Regulated Medical Waste Generator  
Lab Animal Training  
Bloodborne Pathogens Awareness  
Radioactive Waste Generator  
Cryogen Safety  
Laser Safety  
Compressed Gas Safety

Classroom or demonstration:

Benchtop Dispersibles training demonstration

It is typically during the process of submitting your experiment proposal to BNL and scheduling your beam time when you, or your team's Principal Investigator (PI), would be informed of any additional training required for you. Web-based training may be completed in advance.

All Users are also generally required to complete:

- Guest Site Orientation (TQ-GSO), and
- Cyber security (GE-CYBERSEC).

These are web-based training courses. TQ-GSO is required for general access to the BNL site. GE-CYBERSEC is required if you need access to the BNL network and its computing resources.

Work Plan Document:

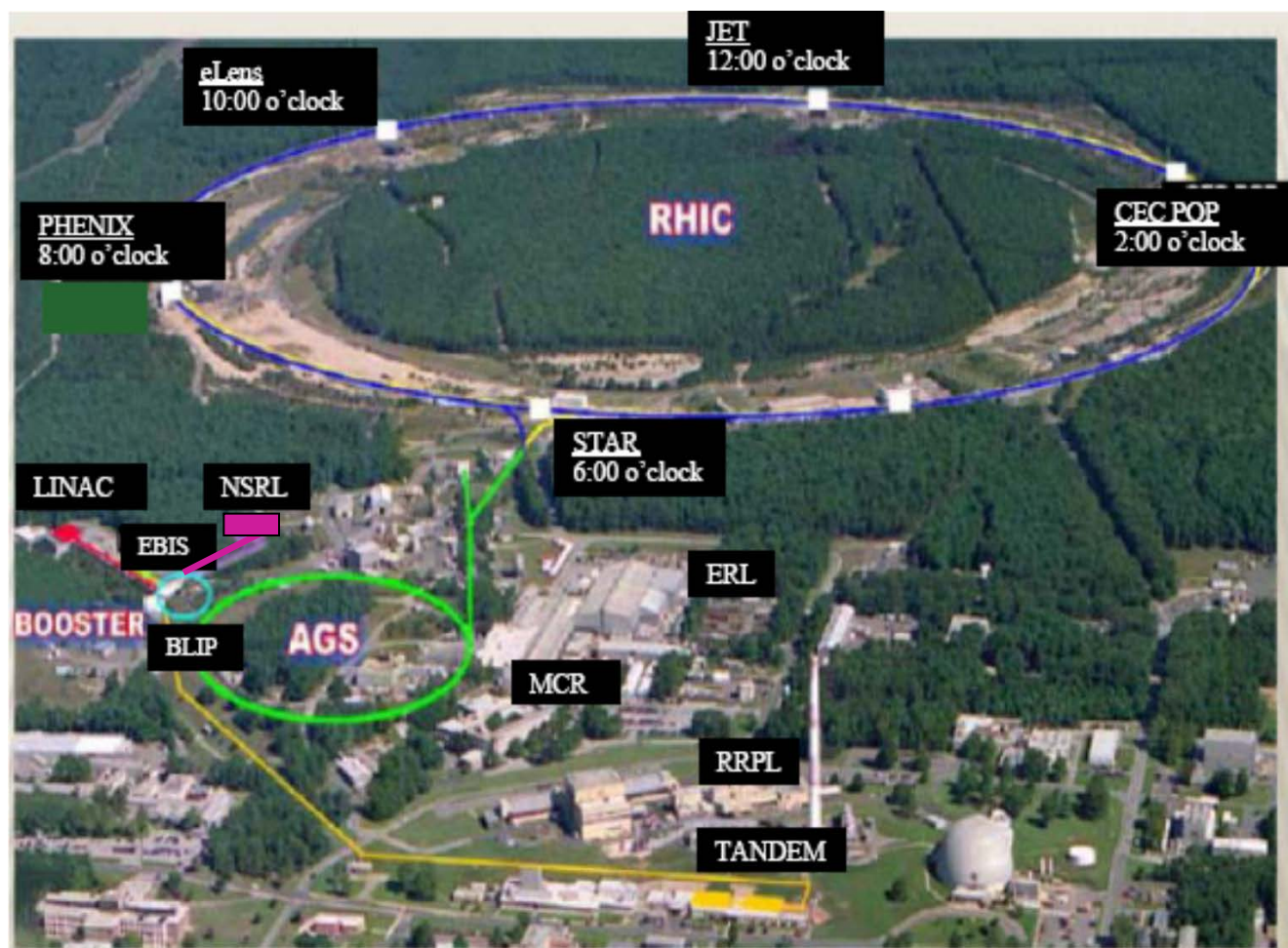
You are required to read and sign a Work Plan document written for your specific experimental run period. A copy is usually located at NSRL Bldg 958 in a 3-ring binder. Prior to start of your work, please read the document and sign the signature sheet provided. Information about the Work Plan document may be obtained from your Experiment Spokesperson or from the C-AD NSRL Liaison Physicist.

Tandem Van de Graff Facility:

Some NSRL Users also carry out NASA experiments at C-AD's Tandem Van de Graff facility, Bldg 901. At the Tandem facility, you will be asked to read & sign a separate Work Plan document and attend an area-specific walkthrough for use of that facility.

Your Experiment Spokesperson, Liaison Physicist and PI are responsible for ensuring the collaboration is qualified to perform their experiment-specific activities.

## Basic Layout Of Collider-Accelerator Department (C-AD) Complex



*Question:* If a Primary Area is entered improperly (for example, by circumventing the interlocked access door entry procedure), could you receive a lethal dose of radiation from exposure to the beam?

*Answer:* Yes. Primary Areas, including the NSRL target room, are to be considered lethal with beam on.

Even if your experiment is not running, beam may be ON in other areas of the C-AD complex. Observe and obey all postings and warning alarms at all times.

## NSRL Bldg 958



West Fifth Avenue



# Research Support Services

A C-AD Liaison Physicist is assigned to your experiment. *The Liaison Physicist is your primary contact for safety related information specific to your experiment.* Generally, the Liaison Physicist is responsible for a specific target station as well as the experiments. Your Liaison Physicist provides expert assistance in beam tuning during the first stage of a beam turn-on. He or she also optimizes the beam during sharing conditions. The C-AD Liaison Physicist should be consulted and should be considered your primary contact to help solve ionizing radiation problems, and to solve other problems of general safety character.

A Liaison Engineer is also assigned to your experimental area. The Liaison Engineer can arrange for such needs as rigging, surveys, safety reviews, electrical work, plumbing, carpentry and air conditioning. Items that require a safety review or other advance approvals are listed in C-AD Operations Procedures Manual (OPM) Chapter 9. The Liaison Engineer should be consulted regarding special needs or modification of the experimental set-up. Your Liaison Engineer was the primary contact for the experimental team during the construction phase of the facility.

The Experiment Spokesperson for your experiment is the person who will act on behalf of all the collaborators on the experiment. His/her specific safety responsibilities are as follows:

- Experiment Spokespersons are responsible for ensuring that all personnel involved with the experiment apparatus are trained in the emergency procedures, and other safety-related procedures assigned by C-AD Safety Committees. These procedures may be associated with mixing flammable gases, moving protective shields into place or use of chemicals and controlled substances.
- The Experiment Spokesperson must inform the Liaison Physicist prior to the introduction of a new hazard. Sufficient time must be allowed for review of modifications prior to planned operations.
- Experiment Spokespersons are responsible for ensuring radioactive sources to be introduced to the area are inventoried and leak checked as required by C-AD and Federal Law. The C-AD Sealed Source Custodian must be notified prior to bringing a source to the C-AD experimental area.
- It is an Experiment Spokesperson's responsibility to ensure that all work by the collaboration is properly planned and reviewed for Environment, Safety & Health (ES&H) issues.

After the reviews by appropriate C-AD safety committees are completed, the Liaison Physicist, Liaison Engineer and the Experiment Spokesperson are made aware of safety requirements for your experiment. The Liaison Physicist, Liaison Engineer or Experiment Spokesperson can provide safety related information specific to your experiment. However, the **Liaison Physicist** should be considered your primary contact for this.

## Contacts

	Phone extension
C-AD Liaison Physicist (Michael Sivertz)	6102
(Adam Rusek)	5830
C-AD Dosimetry Physicist (Chiara LaTessa)	8891
(I-Hung Chiang)	7903
C-AD Liaison Engineer (Charlie Pearson)	7641
(Dave Phillips)	4671
Experiment Spokesperson (Peter Guida)	2913
Bldg Manager for Bldg 958	7641
C-AD ESH Coordinator	4006
C-AD Laser Coordinator	4006
C-AD ESSHQ Division Head	5636
C-AD Associate Chair for Safety	4250
C-AD Department Chair	4619
C-AD Environmental Coordinator	8802
ESD Environmental Compliance Representative	2905
C-AD Maintenance Coordinator	7178
C-AD CAS Watch	2024
Health Physics Office at C-AD	4660
C-AD Main Control Room	4662
C-AD Operations Coordinator	4662
C-AD Rad Sealed Source Custodian	5636
C-AD Training Manager	7343

## Restrictions for Medical Reasons

### What is your responsibility?

If you have a medical condition that you believe should restrict or limit your expected activities here at BNL, please understand it is your responsibility to inform your Experiment Spokesperson of this situation. Our intent is to protect your health and safety, as well as the health and safety of the people around you. Depending on your expected work activities, and depending on any particular medical condition you may have, examples of restrictions that might apply are: no work at heights above 5 feet, no work requiring color discrimination, no entry into magnetic field areas ... etc. The BNL Occupational Medicine Clinic performs periodic routine Physical Exams that identify restrictions for BNL employees. However, for guests/Users, please understand it is your responsibility to notify your Experiment Spokesperson if you believe you have some medical condition that should restrict or limit your expected activities here at BNL.

## Fire or Other Emergency (e.g. Medical Emergency)

The fire safety program at BNL emphasizes prevention through building design and through automatic protection systems.

If you suspect a fire, activate a fire alarm (use a fire alarm pull box if one is in the area) and telephone x2222 or 911.

From a BNL on-site telephone, 911 is the same as x2222.  
From a cell phone, use (631) 344-2222\*.



Either one will notify the BNL on-site Fire/Rescue Group and the BNL on-site Police Group at the same time.



A fire alarm pull-box is located near the entrance to the NSRL target room



Pulling the fire alarm pull-box will send a signal to the Fire House and will give the F/R Group your general location. In the case of a fire, warn others in the area and evacuate as required. If you think you can combat the fire without putting yourself in danger, a fire extinguisher may be effective. **Never let the fire get between you and your escape route.** Use a fire extinguisher only if you are trained and it can be done safely. Only use a fire extinguisher if you're confident in your ability to put out the fire safely. Determine what is burning and select the appropriate fire extinguisher. Fire extinguishers are classified according to their ability to handle specific types and sizes of fires. If you have any doubt, let firefighters handle the situation.

Actions to take in a **Medical Emergency** (Note: Wait for the Emergency Medical Technicians (EMTs) to come to you)

If there is a non-fire emergency such as an injury or illness for which you want the quickest/immediate medical attention for you or for a co-worker:

- pull a fire alarm pull-box if one is in the area (a pull-box is located near the entrance to the NSRL target room), and
- telephone the Fire/Rescue Group (x2222 or 911 from an onsite BNL phone; OR (631) 344-2222 from a cell phone\*), and
- wait for the Fire/Rescue Group Emergency Medical Technician (EMT) to come to you.

It does not have to be a fire to pull a fire alarm pull-box. You may use the fire alarm in a medical emergency. Also still call 2222 or 911, however, and explain the emergency.

Unless an injury is very minor:

**Never** transport the injured person to the BNL on-site Clinic yourself. Wait for Fire/Rescue Group personnel to arrive with the EMT and ambulance. Make sure you pull a Fire Alarm pull-box (if one is in the area) to immediately let Fire/Rescue know of the location of the problem. Follow up immediately with a call to 2222 or 911 to let F/R know it is an injury or illness so the EMT/ambulance are dispatched to the scene (they usually don't send the ambulance for a fire only). If you transport the person yourself, time may be wasted in having the ambulance track you down. In addition, you may be stuck with an injured person who passes out or stops breathing, etc., on the way to the Clinic or you could be nervous and have an accident on the way to the Clinic.

*Question:* You need immediate help in an emergency such as an illness or injury; What do you do?

*Answer:* Pull a fire alarm box (if there is one in the area) **and** call x2222 or x911.

*Question:* There is a fire in your area; What do you do?

*Answer:* Warn others and evacuate the building; pull a fire alarm pull box.

Upon entering any building or experimental area at the C-AD complex one should note the locations of emergency equipment as well as the exit points.

Make a mental note of the following that may be in your work area:

- Exits
- Fire Alarm Pull Boxes
- Fire Extinguishers and their Type
- Intercoms / Telephones
- TLD Requirements
- Conventional Safety Hazards/Postings
- Radiological Safety Hazards/Postings
- Safety Equipment
- Emergency exhaust
- Assembly Areas
- Plectrons (radio controlled electronic alerting devices)

**\* Important:** If you dial 911 from your cell phone you will NOT get the onsite Fire/Rescue Group or onsite BNL Police Group. You will get the offsite county police, which is not the type of help you need for your situation here on site.

## General Hazards

In addition to ionizing radiation, your NSRL target room and other areas associated with Bldg 958 may contain hazards posed by:

- remotely operated equipment
- overhead cranes or hoists (1,000 lb overhead crane in NSRL target room)
- radioactive contamination
- CO2 (used in Bldg 958 cell rooms)
- chemicals
- slips, trips, falls
- posted high noise area
- heavy objects
- mechanical equipment
- working at heights
- magnetic fields
- hot and cold surfaces
- high-voltage and high-current electrical systems

Fully enclosed shoe and long pants are required for entry into Bldg 958.

## Guest, User, Visitor (GUV) Center

All Users are required to check in and out at the BNL GUV Center. The GUV Center is located in building 400; [guvcenter@bnl.gov](mailto:guvcenter@bnl.gov) or telephone 631-344-3333. The GUV Center is a central contact point for services for all guest, users, and visitors and is staffed with employees who know BNL and can assist you in answering questions you may have. During the check-in process you will be familiarized with BNL's commitments and obligations to its visiting population as well as BNL's expectations and requirements for individuals visiting BNL. Before leaving BNL, return any personal radiation monitoring devices (e.g.: TLD) and any access keys that may have been issued to you.

## BNL Computers

Any User, BNL employee, visitor, guest or contractor who is given access to the BNL network and its computing resources must complete a BNL training course titled "Cyber Security". This is a web-based course that may be completed at the BNL GUV Center. It is generally asked that all NSRL Users complete this training.

## C-AD Conduct of Operations

The Collider-Accelerator Department is managed and operated under a written agreement with the U.S. Department of Energy (DOE) known as the “Conduct of Operations” agreement. This means we must follow certain DOE Orders and guidelines in the operation of our accelerator facilities.

We ... employees as well as visiting Users ... are required to be aware of the basic principles of the Conduct of Operations agreement. To summarize, please be aware of the following principles:

- we use written procedures for most operations
- we use trained & qualified personnel
- we require appropriate authorizations and work permits before beginning work or operations
- we must have definitive lines of authority at C-AD\*

\* Responsibility for the safe and reliable operation of the C-AD complex resides with the on-duty Operations Coordinator (OC). This individual is located in the C-AD Main Control Room (MCR) in Bldg 911. The OC is the focal point for all questions or issues related to accelerator operations. (Your Liaison Physicist is your local primary contact for issues related to your experiment).

The OC can be reached at telephone extension 4662. The OC can make any necessary notifications and arrange for assistance when needed.

# Particle Accelerator Safety System (PASS)

## NSRL Target Room Entry & Exit Procedure

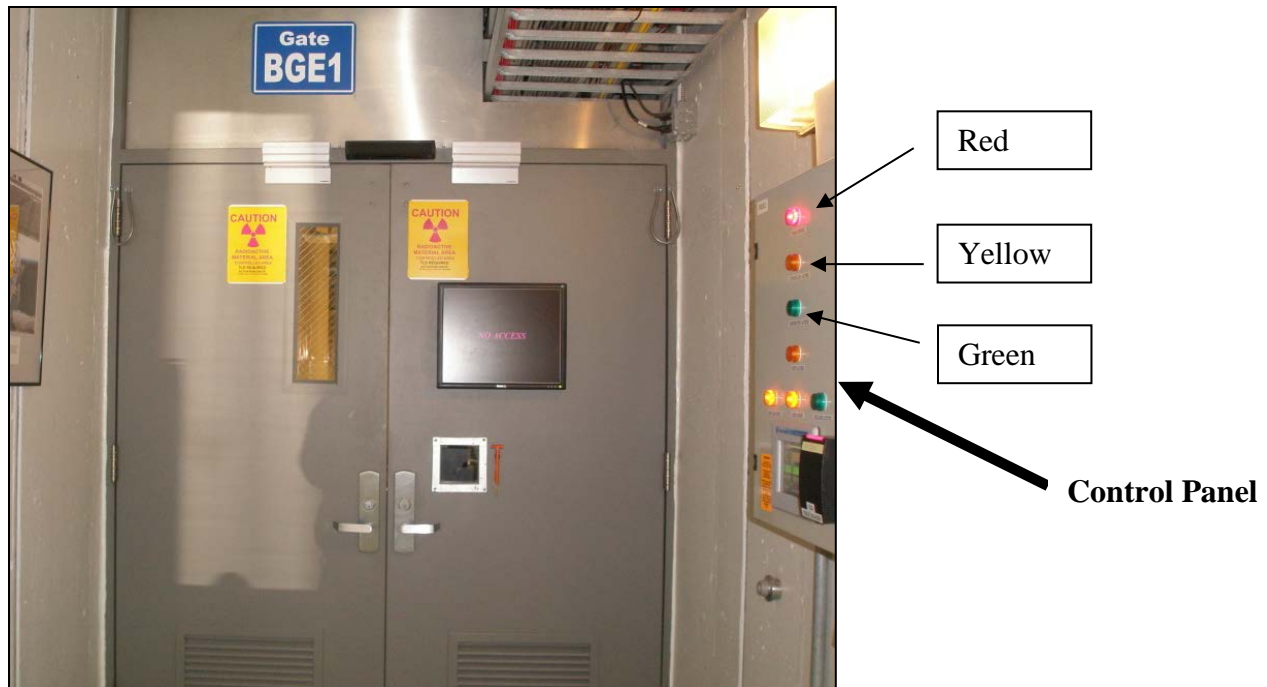
The Particle Accelerator Safety System (PASS) is a major design feature used to protect personnel from exposure to radiation. The system includes interlocked gates (or doors) designed to control access to Primary Areas throughout the C-AD complex. The system is designed to prevent access when the beam is on, or enabled. There are several miles of Primary Area throughout C-AD, and many interlocked PASS gates throughout. For the typical NSRL User, however, you will need to understand the entry and exit procedure only for the one set of doors used for access to the NSRL target room. (You will receive a separate area-specific training walkthrough at C-AD's Tandem Van de Graff facility if you will be working there).

Another function of PASS is that it detects radiation levels outside Primary/shielded Areas using area radiation monitors called "chipmunks".

*Question:* What is the main purpose of the PASS interlocked gates (or doors) to Primary Areas throughout the C-AD complex?

*Answer:* To protect people from radiation hazards.

## How do you enter and exit the NSRL Target Room?



The PASS doors to the NSRL target room can be in one of three basic access control modes:

PROHIBITED Access Mode  
CONTROLLED Access Mode  
RESTRICTED Access Mode

A control panel is located at the entrance to the target room. The top three lights on the panel indicate the access control mode:

Red Light	-	Prohibited Access
Yellow Light	-	Controlled Access
Green Light	-	Restricted Access

Reminder:

There are two minimum training requirements for entry when access is permitted:

- NSRL User Training, and
- BNL's Radiological Worker-1 (RW-1) Training



**Restricted Access Mode** - For this access mode, the Green light (3rd from top) on the control panel would be ON

This is the least restrictive of the three modes. In this mode, beam is off and is not enabled. If your training is current and you've been issued an NSRL plastic orange access card-key, you may enter and exit the target room essentially at will. Each person entering must have their own card-key (and TLD). More than one person entering under one key is considered a violation of procedure and is subject to disciplinary action, unless formal escort procedures are followed.

**To Enter:**

Place your plastic orange access card-key on the card reader. A small green light on the card reader should come on, and the door will open automatically towards you. Enter the labyrinth to the target room. The door will close automatically behind you.

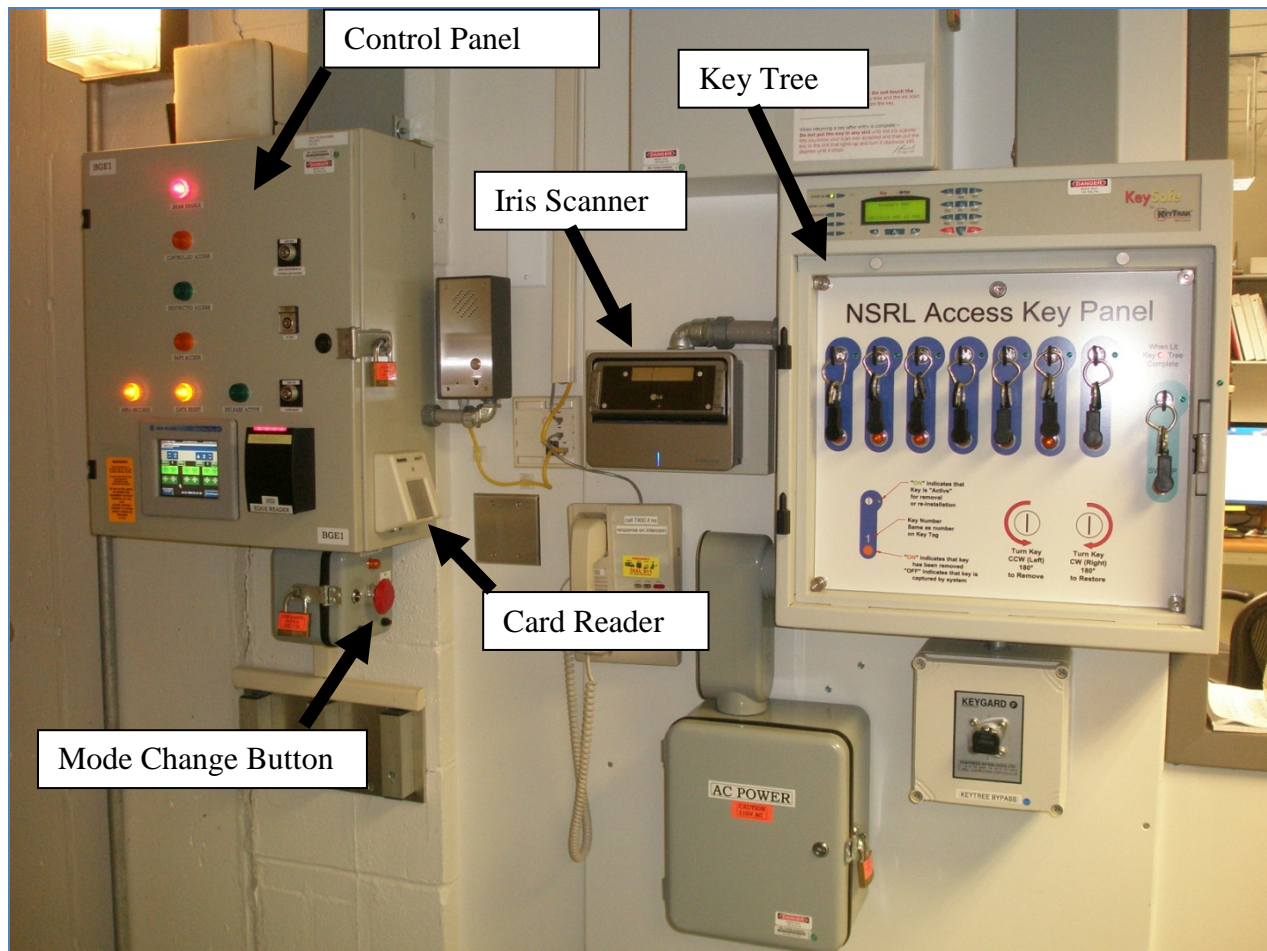
If more than one person is entering: While the door is still open, more than one person may enter through the open door, however each person must still place their card-key on the card reader and see that the small green light comes on. The required training of each entering individual must be current, unless formal escort procedures are followed.

**To Exit:**

Simply approach the doors from the inside. You will be detected by a sensor and the door will open, again automatically. Exit the area, and the door will close behind you automatically.

You are not being monitored (accounted-for) going in or out of the target room during this mode.

Unless there is an emergency, do not manually open the doors. For safety, in an emergency, the doors may always be manually pushed open from the inside.



**Controlled Access Mode** – For this access mode, the Yellow light (2nd from top) on the control panel would be ON

In Controlled Access mode, personnel are monitored (accounted-for) going in and going out of the NSRL target room. The entry/exit procedure uses Iris Recognition\*, a Key-Tree, RFID system and Optical Turnstiles to track people going in and out of the target room.

\* In order to obtain a key from the key tree, new Users must first have their irises enrolled. For iris enrollment, contact the C-AD Training Office at x7007, Bldg 911 Room A128.

Two optical turnstiles in tandem count each person going in and each person going out of the target room. Prior to entry, **each individual** pulls a key from the key tree using their iris recognition. An RFID tag is attached to each key. The RFID system identifies and monitors the specific key going in and going out through the turnstiles. This assures that each entering individual is carrying a key and is accounted for.

To Enter (Note: Your orange plastic card-key will not work in this mode)

1) Go to the target room access area. On the control panel adjacent to the key tree, observe that the yellow light is on (2nd light from top).

2) From a distance of about 10 inches look into the iris scanner and center the bridge of your nose with the red dot seen in the mirror. Once you are recognized, the red dot will turn green and the iris scanner's automated voice will let you know that you have been successfully recognized.

Note: If you are too far or too close, the automated voice will prompt you to move forward or back. Also, there are two up/down buttons on either side of the scanner to adjust the scanner alignment to suit your height.

3) Once successfully recognized, you are permitted to pull a key from the key tree. Turn the key 180 degrees counterclockwise, and pull it out from its slot.

Note: You have a few seconds to pull a key after iris recognition. If the system times-out, simply scan your irises again.

Note: Upon the first person removing the first key from the key tree, the access door (typically the left door) will open, automatically towards you.

Note: Once a key is removed, the key tree cannot be accessed again until a second iris scan, and the same individual cannot retrieve two keys for the same access without a violation. Each trained person entering must pull their own key.

Note: Each key has an RFID tag attached. Each tag has a unique ID based on its slot position in the key tree. Each key is labeled with the number of its corresponding key slot.

4) With the key-tree key & RFID tag, proceed through the open door, through the optical turnstiles and into the labyrinth to the target room.

**Important:** Each person entering must perform their own iris scan and enter with their own key-tree key & RFID tag. More than one person entering under one key/RFID tag or one iris scan is considered a violation of procedure and is subject to disciplinary action.

Note: Only one person may walk through the turnstiles at a time. Before you proceed, wait for the person before you to clear the turnstiles, and observe that the lighted sign mounted on the right-side door displays green, indicating that access is permitted. Two or more people walking through the optical turnstiles together will be sensed and this will "crash" the system and may cause some program delay.

If the lighted sign displays yellow, this means the Sweep is lost; contact the Liaison Physicist in this case.

**IMPORTANT:** You must carry the key, with the RFID tag attached, with you through the optical turnstiles and into the target room. Keeping the key with you while in the target room (a Primary Area) is **important for your safety.** Beam cannot be sent into the target room unless all keys are properly returned to the key tree.

Note: During Controlled Access Mode, the access door will remain open while people are entering and exiting. The turnstile and RFID systems will track all going in and out. Even though the door may be open, please do not mistakenly enter unless you have properly pulled your own key/RFID tag from the key tree, and have it on your person. Entering without a key/RFID tag will “crash” the system and may cause some program delay.

### To Exit:

1) At the exit area, before exiting through the optical turnstiles, wait for the person before you to clear the turnstiles, and observe that the lighted sign to your left displays green, indicating that you may proceed. Two or more people walking through the optical turnstiles together will be sensed and this will “crash” the system and may cause some program delay.

If the lighted sign displays yellow, this means the Sweep is lost; contact the Liaison Physicist in this case.

2) Then simply walk out through the optical turnstiles and out through the open door. The door will have remained open during the access.

**IMPORTANT:** In an emergency, and if the door has closed for some reason, simply open the door manually by pushing on the crash bar on the inside of the door and exit.

3) Proceed back to the iris scanner for iris system logout and key replacement.

4) From a distance of about 10 inches look into the iris scanner and center the bridge of your nose with the red dot seen in the mirror. If you are too far or too close, the iris scanner’s automated voice will ask you to move forward or back. Also, there are two up/down buttons on either side of the scanner to adjust the scanner alignment to suit your height. Once you are recognized, the red dot seen in the mirror will turn green and the automated voice will let you know that you have been successfully recognized.

5) Upon recognition by iris scanner, put the key back in the slot of origin within 4 seconds and turn it 180 degrees clockwise.

Note: You must complete your exit iris scan before replacing the key.

Note: The system will not allow you to put the key in a different slot than it was taken from.

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Please be aware that a camera is continuously recording the target room entrance and exit areas. (No audio). The video is not being continuously monitored, however the recording could be reviewed later as an aid to understanding any mishaps that might occur with the entry and exit process.  
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**Prohibited Access Mode** – For this access mode, the RED light (top light) on the control panel would be ON

Access is prohibited while PASS is in this access mode. During this mode, it is assumed that beam is ON, or beam is enabled. Neither your orange access card-key nor your iris scan will work in this mode. ACCESS IS PROHIBITED.

**Mode Change Button:**

It may be that the top red light on the control panel is on (meaning PASS is set to Prohibited Access Mode) while beam is actually off and not enabled. If you believe this may be the case and you wish to have access, first be sure that there is no irradiation in progress. If in doubt, check with the dosimetry physicists or the Liaison Physicist (LP). Then, push in the red button mounted below the control panel (**or**, ask the LP to do this for you). Observe on the control panel that the red light goes off and the yellow light goes on. This may take a few seconds. You have now changed the mode from “Prohibited” to “Controlled” access.

**Note:** If beam is on and you push in the red mode change button, this will stop the beam. This is safe, **but will cause significant program disruption**.

## Beam Imminent Signal!

The lights dimming or going off in the NSRL target room is the signal that Beam is Imminent!

If procedures are properly followed, there should not be a case when you are inside the Primary Area (NSRL target room) when beam is imminent. If you are inside however, and the lights go off or are dimmed, then do not assume it is a power failure. Assume it is the signal that beam is imminent.

**Your Actions:** Push a CRASH BUTTON and immediately exit the target room.

### CRASH BUTTON



If you are already on your way out of the target room, it is not necessary for you to push a crash button. One can always “crash” out of the target room by pushing open the PASS access door (if it has closed) from the inside using the door’s crash bar.

Pressing crash buttons or pushing opening the PASS access door from the inside will both “crash” the system and prevent beam. Beam stops insert, lights go on, and electrical power to the main magnet bus and RF devices is interrupted. Beam to your area is prevented.

DO NOT PANIC, you have time; 30 seconds minimum.  
(Audio announcements are also made in advance of the beam imminent signal).

After pushing a crash button or crash bar and exiting the area, call the MCR (x4662) and notify them of the location.

*Question:* If the lights go out or are dimmed in a primary area, should it be assumed that loss of electrical power has occurred?

*Answer:* No. It should be assumed that the lights have gone out or were dimmed in order to signal that lethal hazards are imminent; that beam is imminent.

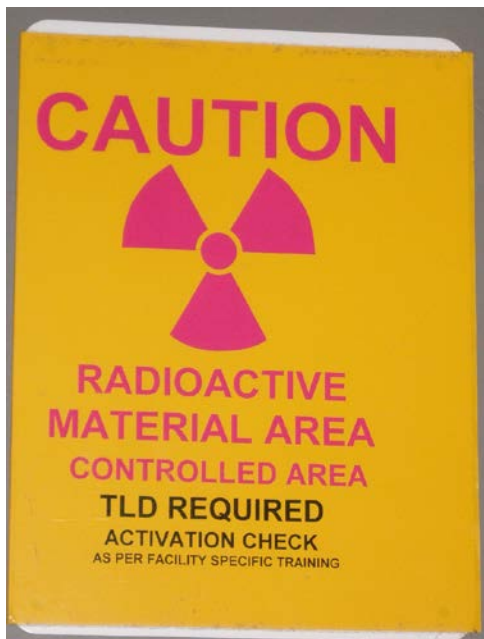
## Power Failure During Prohibited Access Mode

During a power failure, the Particle Accelerator Safety System (PASS) may drop to Controlled or Restricted Access Mode if the battery back-up system also fails. In some areas of the C-AD complex, there may be high levels of residual radiation in primary areas, so people are not to attempt to enter with their key immediately following a power failure. At NSRL, however, at this time, beam intensity is low enough that residual radiation is not a problem. At NSRL, residual radiation (from activated equipment or air activation) has been shown to be low enough that delaying entry is not necessary. There is also continual air exhaust at the NSRL target room that assists with keeping air activity low. If in doubt following a power failure however, you may contact the Main Control Room (x4662) to verify it is safe to enter the area, or consult with the Liaison Physicist.

## Radioactive Material Area

### “ACTIVATION CHECK” Required

During NSRL run periods, the target room is typically posted as:



- RADIOACTIVE MATERIAL AREA
- CONTROLLED AREA
- TLD REQUIRED
- ACTIVATION CHECK REQUIRED

“Activation Check” required means you **must not** remove items from the area without having them checked for activation (radioactivity). All items within the target room are to be considered activated until checked otherwise.



This means your samples must be checked after irradiation upon taking them out of the target room. A C-AD Radiological Control Technician (RCT) is stationed at NSRL Bldg 958 during run periods, and will perform this check for you. Users are not qualified or authorized to perform these activation checks. Activated material must be properly checked, and tagged as required, by a RCT. Note: Performing an "activation" check is different than checking yourself or checking material for "contamination"; the NSRL target room is not a posted Contamination Area.

All samples leaving the NSRL support building (Bldg 958) are to be checked for radioactivity.

Only you can prevent unlabeled radioactive materials from leaving the Primary Area unchecked.

Keep in mind that many small activated parts may be inside Primary Areas and they will not bear any labels, even though the original assembled item may have a label. Unless you follow the rules, unlabeled activated materials could find their way into offices, common experimental areas or waste streams.

Important note: The intent here is that any item that is possibly activated material must be checked. Generally, no item may be released from areas posted "Activation Check" without a Radiological Control Technician (RCT) first checking the item for radioactivity. However, non-activated items that you bring into an area posted "Activation Check" may be removed without an activation check if you know that the item could not have been exposed to beam or have become activated in any other way. If you did not bring the item into the area, however, and you want to bring it out, then you must have it checked for activation. If ever in doubt, have the material checked.

Targets, target holders, specimen holders, or any other objects or materials that are exposed to primary beam may become radioactive and may have to be handled with special care in order to avoid excessive and unnecessary exposure.

*Question:* What does the posting "activation check" mean?

*Answer:* You must have a Radiological Control Technician (RCT) check each item being removed from the area for "activation."

## Radioactive Sealed Sources

Federal rules define sealed sources as any radioactive item manufactured for the sole purpose of using the emitted radiation. Sealed sources are commonly used at C-AD for instrument checks and instrument calibration. The following are not sealed sources: smoke detectors, tritium exit signs, activated beam-line components, activated shields and radioactive materials in-process such as targets or cooling water. If you will be bringing a sealed source to C-AD, even if it is from another on-site BNL Department, contact the C-AD Source Custodian beforehand.

C-AD sealed source users are required to complete the following training:

- C-AD Sealed Source Inventory Procedure (AD-OPM20.1)
- Sealed Radioactive Source Control (HP-RWT-600)
- Radiological Worker I (HP-RWT002)
- Rad Buffer Area Access Training (HP-RWT002A)

Sources may be stored in shielded containers:



Sealed source users are responsible to follow the rules for source procurement, transport by vehicle, safe use and storage.

If you are responsible for a sealed source, then DOE Orders and Federal Law require you to keep track of it in a way that can be audited by the Federal government.

Following are rules that apply to sealed sources: (even if you obtain a source from another on-site BNL Department)

- Contact the C-AD Source Custodian if you are a new sealed source user at C-AD.
- Contact the C-AD Source Custodian if you plan to procure any new source. Sources are required to be inventoried.
- Have all *accountable* sources inventoried and leak-checked every six months by the C-AD Health Physics Office.
- For exempt sources  $\geq 10\%$  of accountable activity level, consult with the C-AD Source Custodian for leak testing and inventory requirements.
- Complete the “Sealed Radioactive Source Data Form” and the “Sealed Radioactive Source Inventory-Leak Test Form” found in the SBMS Subject Area. Forward a copy of the completed forms to the C-AD Source Custodian.
- Notify BNL Nuclear Materials Management (NMM) Group prior to shipping a source to or from BNL.
- Contact the C-AD Source Custodian if you are going to remove a source from the C-AD facility.

Beta, gamma and neutron sources produce radiation levels that may travel many feet in air. The radiation level drops rapidly as the inverse square of distance. This is because most sources are point-like objects.

If you are not sure about the rules or definition of a sealed source, then contact the C-AD Source Custodian.

## Radiation Generating Devices

If you plan to bring a Radiation Generating Devices to a C-AD area, you must contact your C-AD Liaison Physicist beforehand to initiate proper reviews and documentation. Refer to BNL’s SBMS Subject Area for Radiation Generating Devices. RGDs include X-ray devices (analytical and industrial) – e.g. fluoroscopes, neutron generators, and sealed source irradiators.

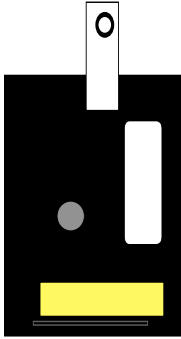
## Transport of Radioactive Materials

Radioactive materials transferred between C-AD / NSRL and another building or location at BNL (for example, to the Medical or Biology Department buildings) must be transported in a government vehicle. Radioactive materials leaving NSRL Building 958 shall be tagged as Radioactive Material (RAM) by a RCT.

# Personal Dosimetry

## Thermo-Luminescent Dosimeter (TLD)

The TLD monitors your exposure to beta, gamma, and neutron radiation. It offers no protection from radiation. TLDs are exchanged on a monthly basis. The TLD is the basis for the legal record of your occupational dose.



Requirements for TLD use include:

- TLDs are worn when required by signs or postings, Radiological Work Permits, and when directed by Health Physics personnel. For example, the NSRL target room posting requires that you wear a TLD for entry.
- TLDs must be worn on the front of the torso, between the waist and the neck unless directed otherwise by Health Physics personnel.
- TLDs are to be returned to a designated TLD location (TLD board) at BNL when not in use.
- TLDs issued at BNL are not to be worn at another facility and dosimetry issued from another facility is not to be worn at BNL.
- Never wear another worker's TLD or allow someone else to wear your TLD.
- Trained personnel receive a TLD with a blue or yellow band on the front of the badge. The color alternates monthly. The exchange currently occurs the first Friday of each month. You must exchange your TLD for the "color-of-the-month" TLD if you are here through the exchange period.

Visitor TLD:

A red band on the front of the badge identifies an untrained visitor TLD. Individuals wearing a visitor TLD are required to be under escort. Specific escort procedures must be followed.

Escorting requires documented approval on an escort form prior to the entry. Please return red visitor TLDs to the TLD board next to the C-AD Training Office daily. (C-AD Training Office: Bldg 911, Room A128)

Report any lost or damaged TLD immediately to the C-AD Training Office or the C-AD Health Physics Office. If a badge leaves the site inadvertently, please contact the BNL Radiological Controls Division, Personnel Monitoring Group, for instructions on how to mail it back.

Please continue to leave badges at a designated location at the end of your workday or shift. Do not take them outside the Laboratory. Most un-returned badges are the result of Users taking them off-site or not returning them at the conclusion of an experimental run. Your continued cooperation in eliminating this practice is appreciated.

# Work Plan

## Screening for Environment, Safety & Health (ES&H) Hazards

Experimental runs are screened for ES&H hazards. This is based, in part, on the proposals submitted by you or your principal investigator for your particular experiment.

Prior to starting their work at NSRL, Users must Read & Sign a Work Plan document prepared for their specified run period. A copy of the work plan document is usually located at Bldg 958 in a 3-ring binder for Users to read, with a signature sheet for you to sign. Additional information about the work plan document may be obtained from your Experiment Spokesperson or C-AD Liaison Physicist.

### **Experiment Reviews -**

All experiments and experimental support equipment must be reviewed by the C-AD Experimental Safety Review Committee (ESRC). It is extremely important that once approved, an experiment may not be changed or added-to without re-review and re-approval. Please consult with your Liaison Physicist, your Experiment Spokesperson or the C-AD ESRC Chairperson if you plan to make any significant change to your original proposal. Please also consult with them if you have questions about this requirement, or if you are not sure if a particular change should be considered significant.

Any material placed in or near the primary beam needs to be reviewed by the ESRC and the ALARA Committees for potential gaseous or particulate releases that could contaminate the area, equipment or personnel, and must be reviewed for potential overheating.

Unplanned changes or additions may result in last minute delays for review and approval.

# Contamination

Dispersible or dispersed radioactive material anywhere may be a contamination concern. The following are examples of what would be a radioactive contamination concern:

- Accidental spill of liquid biological target material after irradiation
- Small pieces of broken or disintegrated beam line instrumentation or target material
- Dispersed contents of fire extinguishers or gas cylinders that reside in primary areas during beam operations
- Leaking water from magnet cooling systems
- Drilling or grinding of materials in radiological areas

## Working with Benchtop Dispersibles

Satisfactory completion of this NSRL User Training as well as a follow-up training demonstration with the Facility Support (FS) Representative or designee will provide limited qualification to perform dispersibles work at NSRL Bldg 958 and at Medical Bldg 490.

Users who need this qualification are those who will work with/manipulate irradiated cells and cell media prior to the material's radioactivity decaying enough to allow it to be release as non-radioactive. As an aid in determining whether or not you fall into this category, the NSRL Work Plan document contains decay tables that estimate how much time you would have to wait for your irradiated sample to be released (per RCT survey) as non-radioactive.

The dispersibles work will be conducted in properly posted areas under the control of a Job-Specific Radiological Work Permit (RWP) and Radiological Control Technician (RCT) coverage. The dispersible work is limited only to sample activity associated with beam irradiation. Dispersible work with samples radio-labeled prior to irradiation requires the full BNL Benchtop/Dispersibles Course (BNL Course # HP-RWT-500). This C-AD NSRL User Training and the follow-up demonstration **does not** qualify you to work with dispersibles at any other facility at BNL (allows work in designated areas at NSRL Bldg 958 and at Medical Bldg 490 only).

Some contamination control work habits:

- Use of absorbent materials in hoods when working with liquids
- Holding absorbents under samples while transporting from primary area to work area
- Frequent surveys of work area
- Establishing a small trash receptacle on the benchtop to minimize the transfer of contaminated materials across the work space
- Housekeeping: store excess materials outside of the work area

If you encounter radioactivity on skin or personal clothing > 100 counts per minute (cpm) above background on a GM "Frisker", stop work, place work in a safe condition, notify others in the area, and notify the Radiological Control Technician (RCT) as soon as possible.

The training demonstration with the FS Rep will cover proper frisking.

## C-AD Administrative Control Levels (ACLs)

Administrative Control Levels (ACLs) are an integral part of the dose reduction scheme at BNL and the C-A Department. These administrative levels are less than the dose limits set by DOE and Federal Regulations. The administrative levels help assure that we do not violate DOE limits.

### **C-AD Administrative Control Levels for Radiation Workers (RW-1 Trained individuals):**

Period	C-AD ACLs	Levels allowed on case-by-case basis with Line Authority Approvals	
	(mrem)	(mrem)	
Calendar Year	<b>1000</b>	1000 to 1250	(with C-AD Chair Approval)
		1250 to 2000	(with Lab Director Approval)
Daily	<b>100</b>	100 to 200	(approval will be on RWP)

### **C-AD Administrative Control Levels for Visitors, Untrained Individuals and Minors:**

#### Visitors, Untrained Individuals

**25 mrem per year**

#### Minors

**25 mrem per year**

Minor (< 18 years) dose limit is 25 mrem per year and parental consent is required. Minors are not allowed to **work** in radiological areas but are allowed to visit or tour radiological areas with parental consent.

#### **Pregnancy**

After a female Radiation Worker voluntarily notifies BNL management in writing that she is *pregnant, she is considered a "declared pregnant worker" for the purpose of fetal and embryo* radiation protection. The dose to the fetus during the gestation period is to be no greater than 350 mrem. After a person voluntarily notifies BNL management that she is pregnant, she must follow-up and notify management in writing when she is no longer pregnant.



## Radiological Work Permit (RWP)

All personnel entering any posted Radiation Area at the C-AD complex or performing dispersible work must sign into and follow the requirements of a C-AD Radiological Work Permit. Persons must read and sign that they are aware of the RWP requirements. RWPs provide a mechanism to document the work review process involving radiation hazards and they can also relate worker exposure to specific tasks.

The NSRL target room is not a Radiation Area when access is permitted and an RWP is not required for entry at this time. (A TLD *is* required).

However, an RWP *is required* for work with dispersible radioactivity. Users who work with/manipulate radio-labeled cell cultures or irradiated cells and cell media prior to the material's radioactivity decaying enough to allow it to be released as non-radioactive, will need to sign into the RWP written for that task.

The Support Building itself (Bldg 958) is not a Radiation Area and an RWP is not required for entry into the building.

## Radiation Surveys and Chipmunks

Radiation surveys of experimental areas are conducted by Radiological Control Technicians (RCTs). Surveys are done following a shutdown in some cases, and whenever required by a Radiological Work Permit (RWP). Records of surveys are maintained by the C-AD Health Physics Office.

During a running period, continuous area monitoring is performed by instruments called "chipmunks", which alarm in the C-AD Main Control Room if dose rate set points are reached. Some chipmunks will trip beam off if certain set points are reached.

### Radiation Monitors (Chipmunks) Example:



The chipmunk has red, yellow and green indicator lights on top, and an analog display in front. A chipmunk will display a red blinking light for radiation levels greater than 20 mrem/hr, a yellow blinking light for levels greater than 2 1/2 mrem/hr, and a green blinking light when radiation levels are at ambient conditions or less than 2 1/2 mrem/hr (numbers are approximate).

If you see a Chipmunk in the red or yellow, take note of the Chipmunk location number, notify your collaborators to leave the immediate area, leave the area and call the MCR for further instruction.

Chipmunk readings are also recorded continuously and maintained in a database for later retrieval and review. Chipmunks are capable of alarming locally and are stationed at fixed locations in order to monitor high occupancy areas and other areas of interest.

There are approximately 100 chipmunk monitoring devices in use at this time at the C-AD complex. They have pre-designated alarm levels established by the Radiation Safety Committee. Main Control Room Operators are trained to respond to alarms and investigate the cause, even if it means interrupting the physics or radiobiology program.

## Animal Stays at NSRL

No animals can be removed from the Brookhaven Lab Animal Facility (BLAF) and maintained outside the BLAF (e.g.: at NSRL) for more than 24 hours (12 hours for USDA regulated species). Requests for exceptions to this rule due to extenuating circumstances may be reviewed and approved by the BLAF Manager. (Ref: Institutional Animal Care and Use Committee (IACUC) Dec 9, 2003 meeting minutes).

## Laser Safety

Use of Class II and IIIa lasers require a permit. The alignment lasers at the NSRL target room are Class II, for which a permit is in place.



If you have questions regarding lasers, you may contact the C-AD Laser Coordinator.

Some general rules and good practices:

- Never intentionally stare into the laser beam.
- Never intentionally aim the laser beam at oneself or another person, particularly in the facial area.
- When using alignment lasers, minimize non-essential personal in the area.
- The laser should be turned off when not in use.

Use of higher class lasers, Classes IIIb and IV, requires additional Laboratory training as well as a Laboratory Standard Operating Procedure (SOP).

## Compressed Gas Safety

### General Rules for Cylinder Handling

Note: Additional BNL Training is required if you will be handling compressed gas cylinders

It is preferred that you have BNL personnel handle compressed gas cylinders for you. This can be arranged through your Liaison Physicist or Liaison Engineer. If you must handle compressed gas cylinders, keep the following precautions in mind (you would also be required to take BNL's Compressed Gas Safety Training):

- Do not drop cylinders or permit them to violently strike each other
- Do not roll cylinders in a horizontal position
- Do not drag cylinders
- Do not handle cylinders with oily hands or oily gloves (This is especially important when handling oxygen and other oxidizers)
- If hoisting is necessary, use a suitable cradle or platform
- Do not lift a cylinder by its cap
- Keep cylinder caps on the cylinder whenever they are not in use
- Transport cylinders using a cart or hand truck designed for that purpose
- Whenever placing a cylinder in service, check the hydrostatic test date (5 year max between dates)
- Tear off the bottom of the Cylinder Status Tag and write the name of the assigned user on the tag indicating that the cylinder is in use

## Handling Lead (Pb)

If you need to handle lead, contact your Liaison Physicist, Liaison Engineer or the C-AD ESH Coordinator. Handling lead may be hazardous. To handle lead, you are required to have additional laboratory training, use personnel protective equipment and follow strict work planning procedures.

Lead may be found in brick, sheet, or cast forms, or as wool which is used in lead blankets. In most applications, the bare metal should be covered or painted if practicable. You need to wear safety shoes and gloves when handling lead bricks or sheets of lead. **Handling of the bare metal is not permitted (must use gloves) and safety shoes may be required.**

You are not allowed to shape, drill, or otherwise work with lead in any way that causes it to become dispersible. If you require that lead be shaped or cut, then contact your Liaison Physicist, Liaison Engineer, or the C-AD ESH Coordinator.

# Users of Cell Laboratories

## Carbon Dioxide (CO<sub>2</sub>) Use at NSRL

At NSRL:

Cell Labs C1 and C2  
Outside Target Gate  
Target Room and Target Area

Carbon Dioxide (CO<sub>2</sub>) is used in the cell laboratories at NSRL. Primarily it is used in the operation of the cell incubators.

Carbon dioxide gas is colorless and odorless. It will not burn. It can displace oxygen in air; it may accumulate in low areas. Carbon dioxide is a very mild central nervous system depressant.

What are the main health hazards associated with breathing carbon dioxide gas?

Carbon dioxide is naturally present in the atmosphere at levels of approximately .035% (350 ppm). Short term exposure to concentrations above 1.5% (15,000 ppm) may produce a feeling of an inability to breath (dyspnea), increased pulse rate, headache, dizziness, sweating, restlessness, disorientation, and visual distortion.

Briefly, what do I need to know about the CO<sub>2</sub> warning system at NSRL, and what do I need to know about how to respond to an alarm?

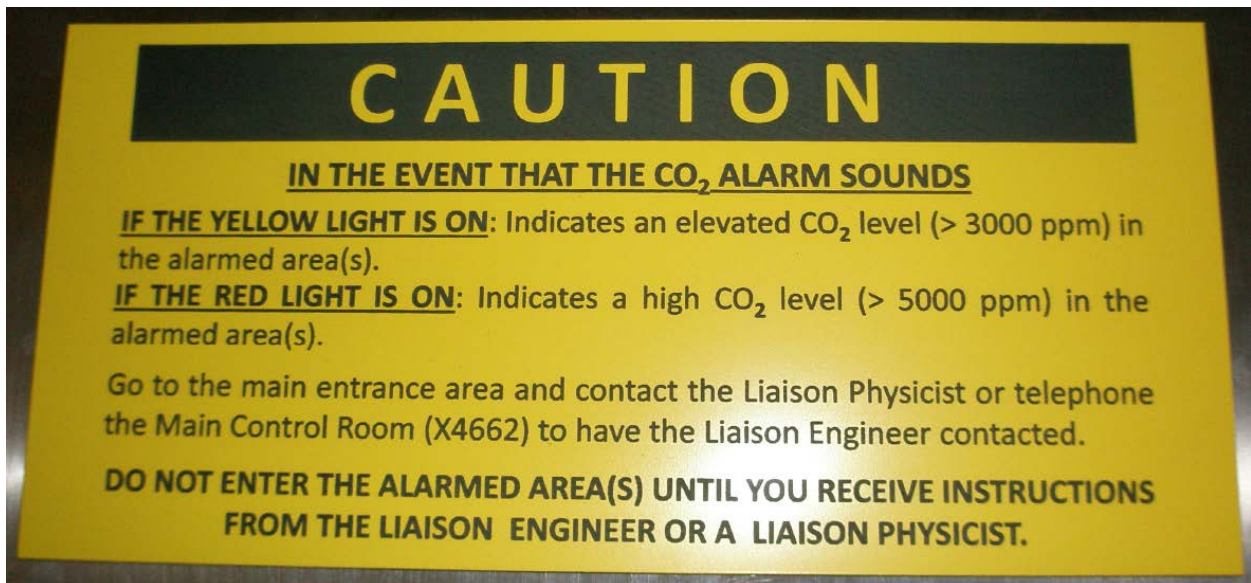
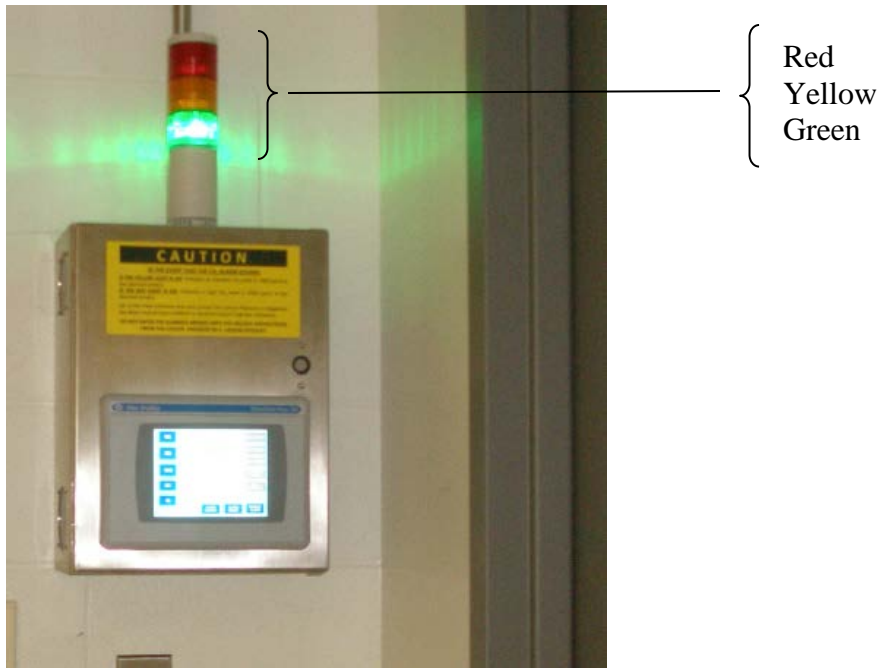
In the cell labs there are carbon dioxide monitors. These monitors contain a digital display indicating the CO<sub>2</sub> concentration in the atmosphere. There is also an audible alarm and yellow and red flashing lights when the CO<sub>2</sub> levels exceed certain values.

Yellow Light: CO<sub>2</sub> > 3,000 ppm

Red Light: CO<sub>2</sub> > 5,000 ppm

If an alarm annunciates, leave cell labs, warn others to leave the cell labs, and proceed to the main entrance area of Bldg 958. Then contact the Liaison Physicist (LP), or telephone the C-AD Main Control Room (x4662) to have the Liaison Engineer (LE) contacted.

DO NOT enter the alarmed area(s) until you receive instructions from the LE or LP.



## Eye Protection in NSRL Labs

Pay attention to postings to the entrances to the cell and animal labs at the NSRL facility. For example, entrances to the cell labs are typically posted as requiring eye protection when manipulating biological materials or handling chemicals.



## Deliveries to NSRL Bldg 958 or any other C-AD Facility

All deliveries to the BNL site should be made to Shipping & Receiving Building 98; for normal business hours. Arrangements can be made with the C-AD Main Control Room for off-hour deliveries. Make off-hour arrangements in advance. When placing an order, inform the sender to address the package to Building 98, and also inform them to include your name and contact information on the package so that personnel receiving the package at BNL have a way to contact you. Packages arriving without a name may be sent back.

Deliveries are not to be made to other buildings in the C-AD complex without pre-review and pre-approval of the C-AD ESSHQ Division Head or designee.

**Caution:** Any deliveries to NSRL Bldg 958 or any other C-AD facility that could introduce any hazard must be pre-reviewed and pre-approved. Please contact your Liaison Physicist as soon as possible before delivery so that proper reviews and approvals may be completed. Examples of what could introduce a new hazard are lasers, Radiation Generating Devices (examples include analytical or industrial X-ray devices (e.g. fluoroscopes), neutron generators, sealed source irradiators), chemicals .. etc. If you are not sure if what you plan to bring to the facility needs to be pre-reviewed & pre-approved, please discuss it with your Liaison Physicist beforehand.

Under the Price-Anderson Amendments Act (PAAA), we are required by Federal law to obey all safety rules (radiological and non-radiological) or face stiff penalties if we do not. All persons, including delivery people, who enter areas posted for radiation protection or for other safety hazards must be properly trained, or they must be formally escorted by a trained worker.

# Shipping Off Site

(Radioactive, Hazardous or Biological Materials)

If you are shipping items off site, ask yourself the following questions

Is the item radioactive?

To check if items are radioactive contact Health Physics x 4660. Radioactive Materials must be shipped through the BNL *Nuclear Materials Management (NMM) Group* x5233.

Does the item contain hazardous material?

Contact C-AD Environmental Coordinator x8802.

Does the item contain biological material?

Contact your Experimental Spokesperson (Peter Guida)

**If still unsure of how to ship material on or off site .... then contact your Liaison Physicist or seek additional assistance from an appropriate BNL Subject Matter Expert (SME).**

Individuals transporting biological materials to and from the BNL site must comply with protocols set forth by the BNL Medical and Biology Departments.

## Biological On-Site Transport

All on-site transport of biological materials to and from the C-AD experimental facilities must use Laboratory Animal Care Vehicles or Government Vehicles.

## Hardhat Policy

You are required to wear a hardhat:

- At all times at construction sites
- When people are working overhead
- When overhead cranes are operating above you



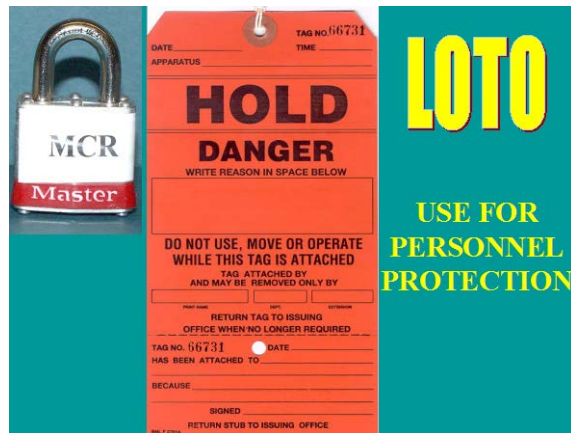
## Orange Tags

Devices sensed by the Particle Accelerator Safety System (PASS) must remain correctly connected. To help ensure personnel do not disconnect or alter these devices without following approved procedure, the C-AD Access Controls Group identifies some such devices with an orange warning tag. In the experimental areas, these tags alert personnel that the device is critical to safety and to the operation of PASS. Do not move these devices since relocation will compromise their effectiveness. Contact the Main Control Room if these devices are inhibiting your work.



For example, chipmunks are tagged to indicate they are connected to PASS. They will trip beam off if certain area dose rate set points are reached.

## Lock Out / Tag Out (LOTO)



You may encounter red LOTO locks & tags. LOTO is used at the Laboratory to protect personnel from hazardous energy sources. To prevent accidental radiation exposure ("RS" LOTO is discussed below), electrical shock or other hazards from different sources of energy, the LOTO lock or tag should only be removed by the individual who attached it. Under rare circumstances, when the individual who attached the LOTO is not available, the LOTO can be removed by a committee of three other employees provided a specific C-AD procedure for this is followed.

All personnel who work on electrical circuits that are powered through circuit breakers, disconnect switches and/or fuses, must LOTO the circuits. OSHA, NFPA, BNL and C-AD require that all workers performing LOTO be specifically trained and qualified for the task. If you or your co-workers are required to perform LOTO, contact your Liaison Physicist or Experiment Spokesperson. This User training does not allow you to place or remove locks or tags.

## Radiation Safety Lock out / Tag Out (RS LOTO)

**BROOKHAVEN NATIONAL LABORATORY  
COLLIDER ACCELERATOR DEPARTMENT**

**RADIATION LOCKOUT**  
USERS MUST BE TRAINED IN  
COLLIDER ACCELERATOR DEPARTMENT  
OPM 9.1.16

**HOLD**

**DANGER  
DO NOT  
OPERATE**

RADIATION LOCKOUT  
SEE OTHER SIDE

DATE \_\_\_\_\_ TIME \_\_\_\_\_  
RAD. AREA \_\_\_\_\_

**HOLD**

**DANGER**  
WRITE REASON IN SPACE BELOW

DO NOT USE MOVE OR OPERATE  
WHILE THIS TAG IS ATTACHED

TAG ATTACHED BY  
AND MAY BE REMOVED ONLY BY

PRINT NAME \_\_\_\_\_ COLLIDER  
ACCELERATOR  
DEPARTMENT  
DIVISION \_\_\_\_\_ EXTENSION \_\_\_\_\_

Tag NO. 3550 RETURN TAG TO MCR  
WHEN NO LONGER NEEDED

Tag NO. 3550 Date: \_\_\_\_\_

Attached to: \_\_\_\_\_

Signed: \_\_\_\_\_

Liaison Physicists, Liaison Engineers, Access Controls Group staff, Operations Coordinators, members of the Radiation Safety Committee, and certain other personnel perform RS LOTO. They must follow a specific procedure in order to lock out and tag out equipment or beam lines for radiation protection. Equipment or beam lines are generally locked out during barrier modifications or barrier removals, or whenever PASS alone does not provide the required protection. Do not alter or otherwise tamper with equipment that bears the RS LOTO tag. This User training does not allow you to place or remove locks or tags.

## Chemical Safety

For your safety, purchased chemicals are inventoried by the Laboratory prior to delivery for end use. If you plan to bring chemicals to BNL, please consult with your Experiment Spokesperson beforehand to assure you follow proper BNL delivery and inventory requirements. All chemicals, including anesthetics, to be used in your experiments must be clearly indicated in your experimental proposals.

If you bring un-inventoried or un-approved chemicals on site, contact your Liaison Physicist to have these chemicals inventoried and bar coded prior to use.

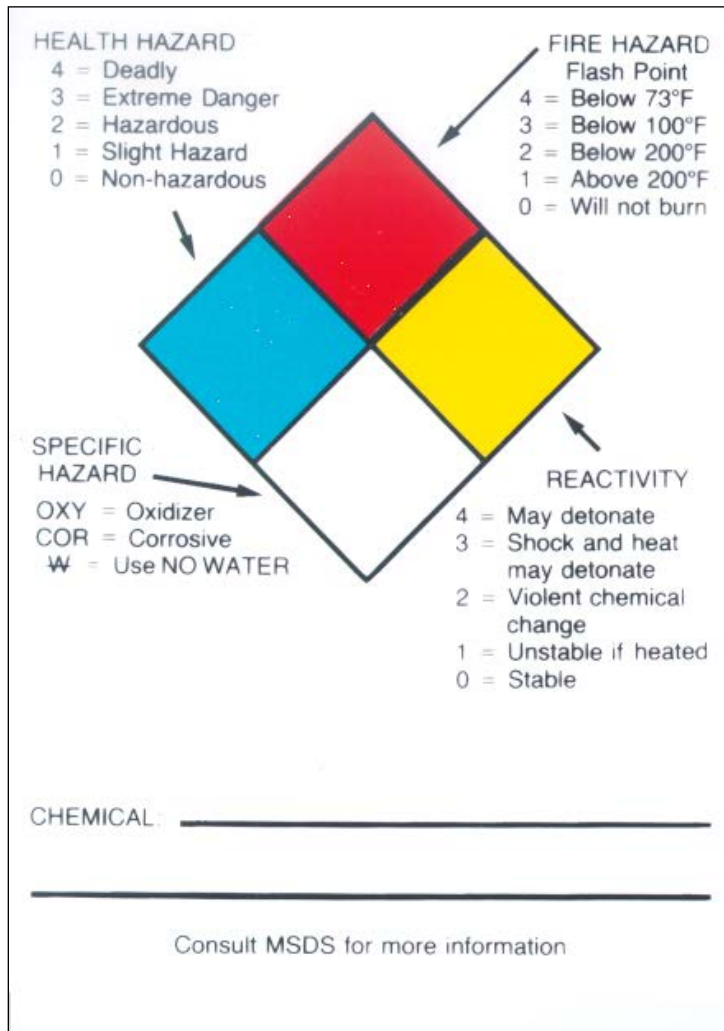
The use and inventory of **Controlled Substances** at the laboratory is strictly regulated. Contact your Experiment Spokesperson to ascertain the required documents and procedures prior to using and bringing any controlled substance onto the Laboratory site.

## Information on Hazards

### Your Right to Know

You have the right to know of any potential health and safety hazards in your workplace whenever the potential for exposure to such hazards exists. If you would like specific safety and health information about your workplace, you may contact the C-AD ESH Coordinator. The ESH Coordinator can provide you with information on the Laboratory's policy on hazardous material, and on how to obtain Material Safety Data Sheets (MSDS) and how to interpret them. MSDSs may also be obtained from the BNL Chemical Management System web site (<http://intranet.bnl.gov/esh/cms/>). Examples of information that may be found on an MSDS are: name of the chemical, manufacturer, hazardous ingredients, physical characteristics, fire and explosion hazard data, reactivity data, health hazard data, precautions for safe handling and safety control measures.

National Fire Protection Association (NFPA) diamonds appear on various containers or structures that contain hazardous materials:



The ESH Coordinator or C-AD Safety Engineering can explain the labeling system and can provide information on how to select and use protective equipment.

## Personal Protective Equipment (PPE)

Department safety policy states that each workplace should be created and maintained in a manner that minimizes safety and health problems. For some jobs, eliminating the hazard is not always practical. Therefore, in some cases protective clothing and protective equipment is required for safety. Plan your work in advance. Consider whether PPE may be needed. For approvals and review of the use of PPE contact the C-AD ESH Coordinator.

# Waste Disposal



## CAUTION:

Improper disposal of radioactive or hazardous waste may result in fines, criminal prosecution, and facility shutdown. Contact the C-AD Environmental Coordinator or the ESD Environmental Compliance Representative well in advance of establishing any new airborne, liquid or solid radioactive or hazardous waste stream. These individuals are familiar with rules, permits, authorizations and analysis requirements necessary for proper disposal.

Removing waste from the Laboratory is complex and costly. Your cooperation is necessary in order to control waste according to Federal, State, and Suffolk County regulations. Additionally, the regulations of States where waste from C-AD is ultimately disposed of must also be followed.

Some general rules and guidance:

- Do not place clean materials in radioactive waste bins
- Do not place radioactive waste materials in clean waste bins
- Do not place hazardous waste materials in radioactive or in clean waste bins
- Substitute reusable materials where possible
- Use minimum quantities of materials
- Segregate wastes
- Do not leave unnecessary items in primary areas

Note: if you are unsure whether or not the waste material is radioactive, hazardous or clean, please ask for assistance.

**DO NOT** leave medical or biological waste items at the C-AD experimental facility. *All such waste is the responsibility of the Experimenter/User to have it brought back to the BNL Medical or Biology Department.*

Each person is responsible to ensure that they handle, accumulate or dispose of waste using adequate controls and documentation. Your Liaison Physicist can explain those controls, or you may contact the C-AD Environmental Coordinator or the ESD Environmental Compliance Representative for details.

# Spills

The C-A Department is required to report spills internally, externally (to external organizations such as NY State agencies, DOE) or BOTH. C-AD must report **quickly** to external agencies on spills that impact the environment. Even minor events such as spilling any amount of oil in an outdoor area to soil or a waterway require reporting. If you spill any hazardous or industrial material outdoors to soil or a waterway, or anywhere inside and the spill is beyond your control, call x2222 or 911 to report the spill.

From a BNL on-site telephone, 911 is the same as x2222 →  
From a cell phone, use (631) 344-2222 \*

Either one will notify the BNL on-site Fire/Rescue Group and the on-site BNL Police Group at the same time.

Then call the C-AD Main Control Room, the C-AD ESSHQ Division Head or the C-AD Environmental Coordinator. When reporting, give your name and information on spill location, type of material and approximate amount (as best as you can). **Do not leave a message on an answering machine as notification.**

The rules are such that we must *consider* reporting spills of any type or size.

When must a spill be reported by calling 911 or x2222?

- Unexpected releases of oil, hazardous substances or radioactive materials known or suspected to have impacted the environment (including spill to the soil or a waterway, regardless of size of spill)
- Any hazardous material spill where your actions would result in exposures to chemicals above established safety limits
- Spills where you possess neither appropriate equipment nor training to mitigate the incident
- Airborne releases of hazardous materials or spills that are likely to result in an uncontrolled release of the hazardous material

When do I not have to call in a spill to 911 or x2222?

All of these must be met:

- The spill is onto an impermeable surface
- The material spilled is not highly toxic or highly volatile
- The person responding to the spill has appropriate training and materials to clean up the spill
- For petroleum based products, the volume of the spill is less than 5 gallons
- The spill is cleaned up immediately

**\* Important:** If you dial 911 from your cell phone you will NOT get the onsite Fire/Rescue Group or onsite BNL Police Group. You will get the offsite county police, which is not the type of help you need for your situation here on site.

## Price-Anderson Amendments Act (PAAA)

It is important to make you aware of the absolute requirement to follow all safety rules (both radiological and non-radiological) at C-AD and BNL facilities. The Price-Anderson Amendments Act (PAAA) is a Congressional Act which provides the Federal Government the ability to impose enforcement penalties if you do not follow the requirements fully. If requirements are violated, enforcement penalties may be imposed against Brookhaven Science Associates (BSA), or even against individuals. Personnel have been the subject of criminal investigations when found to *willfully* violate radiological requirements, such as removing a radiation barrier.

When signing documents related to safety, an employee or User is essentially confirming that he or she will do his or her assigned work according to the rules. The signature does not mean that the individual is guaranteeing that the work will be carried out perfectly or that there is no potential for a violation. It does mean that the individual is performing his or her duties to the best of their ability and has made a good faith effort to comply with the safety requirements. A "good faith effort to comply with the rules" means that the employee or User has familiarized him or her-self with the requirements that fall within his or her area of responsibility.

DOE has put safety requirements into the "Code of Federal Regulations" (CFR), Title 10 "Energy", Parts 835 and 851. These are often referred to as: 10 CFR 835 and 10 CFR 851.

10 CFR 835, Occupational Radiation Protection  
10 CFR 851, Worker Safety & Health Program

### WARNING

It should be understood that any person who intentionally violates a safety requirement, regardless of whether or not the person signs any document related to compliance, might be subject to criminal prosecution or other disciplinary action.

The intent of the Price-Anderson Amendments Act is to protect the health and safety of workers and the general public.



## Safety Attitude

We know from national accident statistics that 10% of accidents result from unsafe conditions and that 90% result from unsafe acts. At C-AD, our experience has also been that accidents and reportable occurrences are largely due to unsafe acts. We can and will continue to engineer hazards out of the C-AD facilities. However, you are the person most responsible for your safety, and your attitude with regard to following the rules will always have the greatest impact on safety at C-AD. Rules shall be followed even when you are short-handed. Do not violate safety rules to get the job done.

*Question:* Who is the person most directly responsible for your safety?

*Answer:* You are the person most directly responsible for your safety. Use common sense. Never assume you know all the hazards. When in doubt, consult an expert. Your Liaison Physicist can assist you with safety concerns.

We strive to maintain an excellent safety record in such a complex environment without undue inconvenience to the Users. With your help, we have reduced fire losses, radiation dose, reportable occurrences, environmental releases and injuries. We can assure the continuity of this safety record only by having the active cooperation of each individual who has access to the experimental areas. Each of you must familiarize yourselves with applicable safety regulations and experiment procedures.

In the recent past in New Jersey, an Exxon worker did not turn off an ignition source, which was the truck he drove to a gas storage site, he did not wear his protective clothing to perform the job, and he did not follow a procedure that minimized gas leakage when he opened valves. These were all relatively small failures that added up to a tragedy. A film about this incident and the personal consequences is available for viewing (~1 hour long) from the BNL Safety and Health Services Division. See the C-AD Training Coordinator if you want to view this film. Likewise, simple failures have added up to major disruptions at BNL, such as not installing groundwater wells south of the HFBR or not installing an interlock on the C-line diffuser at AGS. The risk of losing 500 jobs due to a forced shutdown is very real at BNL since our work is radiological in nature. We do not have to ignite a few million gallons of gasoline in order to have upheaval and misfortune.

Many “errors” in series must usually occur to cause an accident. For a single accident there may be many causes and sub-causes, and certain combinations of these give rise to accidents. From a simple viewpoint, the causes can be grouped into the following two categories:

a) Behavioral - This category includes factors pertaining to the worker, such as improper attitude like the Exxon worker, or lack of knowledge, lack of skills and inadequate physical and mental condition. In the case of the Exxon worker, his attitude was based on years of experience in which nothing ever went wrong for him whenever he took a short cut.

b) Environmental - This category includes improper protection from hazardous work elements and degradation of equipment through use and unsafe procedures and inadequate maintenance. Major accidents are rarely, if ever, the result of a single cause or act. You can view an accident as toppling dominoes. The accident will occur if the sequence of events lets all the dominoes topple to the last. If one or more of the dominoes is removed, then the last domino toppling, which is the accident, probably won't occur.

After an accident, most people tend to look for "things" to blame, because it's easier than looking for "root causes," such as those listed below. Consider the underlying accident causes described below. Have you been guilty of any of these attitudes or behaviors? If so, you may not have been injured, but next time you may not be so lucky.

**Taking Shortcuts:** Every day we make decisions we hope will make the job faster and more efficient. But do these time savers ever risk your own safety, or that of coworkers?

**Being Over Confident:** Confidence is a good thing. Overconfidence is *too much* of a good thing. "It'll never happen to me" is an attitude that can lead to improper use of procedures, tools, or methods in your work.

**Starting a Task with Incomplete Instructions:** To do the job safely and correctly the first time you need complete information. Have you ever been sent to do a job, having been given only a part of the job's instructions? Don't be shy about asking for explanations about work procedures and safety precautions. It isn't dumb to ask questions; it's dumb not to.

**Poor Housekeeping:** When managers, supervisors or safety professionals walk through your work site, housekeeping is almost always an accurate indicator of your attitude about safety. Poor housekeeping creates hazards of all types.

**Ignoring Safety Procedures:** Purposely failing to observe safety procedures can endanger you and your coworkers and cost you your job.

**Mental Distractions from Work:** Having a bad day at home and worrying about it at work is a hazardous combination, and visa versa. Dropping your 'mental' guard can pull your focus away from performing any task safely including changing the gas bottle on your barbecue. You can also be distracted when you're busy at work and a friend comes by to talk while you are trying to do a hazardous job. Don't become a statistic because you took your eyes off the job at hand "just for a minute."

**Failure to Pre-Plan the Work:** Job Hazard Analysis and Enhanced Work Permits are an effective way to figure out the smartest ways to work safely and effectively. Being hasty in starting a task or not thinking through the process can put you in harm's way. Instead, Plan Your Work and then Work Your Plan.

## List of Acronyms

ACL	Administrative Control Level
AGS	Alternating Gradient Synchrotron
ALARA	As Low As Reasonable Achievable
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
C-AD	Collider-Accelerator Department
CAS	Collider-Accelerator Support Group
DEC	Department Emergency Coordinator
DOE	United States Department of Energy
EMT	Emergency Medical Technician
ESD	BNL Environmental Services Division
ES&F	C-AD Experimental Support and Facilities Division
ESH	Environment Safety & Health
ESRC	Experimental Safety Review Committee
ESSHQ	Environment, Safety, Security, Health & Quality Division
FS	Facility Support
HP	Health Physics
IACUC	Institutional Animal Care and Use Committee
LEC	Local Emergency Coordinator
LOTO	Lock Out Tag Out
MCR	Main Control Room
NFPA	National Fire Protection Agency
NSRL	NASA Space Radiation Laboratory
NMM Group	BNL Nuclear Materials Management Group
OC	Operations Coordinator
ODH	Oxygen Deficiency Hazard
OPM	C-AD Operations Procedures Manual
OSHA	United States Occupational Safety and Health Administration
PAAA	Price-Anderson Amendments Act
RAM	Radioactive Material
PASS	Particle Accelerator Safety System
RCD	BNL Radiological Control Division
RCT	Radiological Control Technician
RGD	Radiation Generating Device
RHIC	Relativistic Heavy Ion Collider
RW-1	Radiological Worker-1 Training
RWP	Radiological Work Permit
SRD	Self-Reading Dosimeter
TLD	Thermo-Luminescent Dosimeter