COLLIDER-ACCELERATOR DEPARTMENT

COLLIDER USER TRAINING

Radiation Safety

Conventional Safety

Access Control

INFORMATION GUIDE

Includes Equivalency for training courses:

- General Employee Radiation Training (GERT)
- Oxygen Deficiency Hazard (ODH), Class 0 Areas

COLLIDER USER TRAINING

LEARNING OBJECTIVES OR WHY TAKE THIS COURSE?

This course is required if you want unescorted access into Collider experimental areas. Unescorted access requires you to have facility-specific knowledge. This training alone does NOT qualify you to perform work at your experimental area. As a minimum, you are also required to read & sign a work plan document specific to your experiment. Information about the work plan document may be obtained from your Experiment Spokesperson or from the Collider-Accelerator Department (C-AD) Liaison Physicist for your experiment.

Other additional training may be required depending on your work activities. For example, working at heights, working in confined spaces, electrical work, performing LOTO, working in magnetic fields, crane operation, use of a man-lift, entering Radiation Areas, entering areas that require a TLD (e.g. the Collider Tunnel), using machine shop equipment … etc may require additional training. You should consult with your Spokesperson or Liaison Physicist regarding additional training. Enhanced Work Planning (Work Permit) may be required as well.

If you are a Shift Leader or Period Coordinator at your experiment, you are also required to complete additional training, including a Read & Acknowledgement (R&A) of specific C-AD procedures. The R&A training will include Emergency Procedures for your experimental area. Information about this training may be obtained from your Experiment Spokesperson or from the Collider-Accelerator Department (C-AD) Liaison Physicist for your experiment.

This course provides you with basic information about the access control system at the Collider, the physical and administrative controls that prevent accidental exposures to radiation in Primary Areas, Enhanced Work Planning, and certain conventional safety hazards. The course includes an approved equivalent for BNL courses:

General Employee Radiological Training (GERT - for access to C-AD areas only), and Oxygen Deficiency Hazard Class 0 (ODH-0) Training.

GERT allows Users access to Controlled Areas. A Controlled Area is a posted area established to protect individuals from exposure to radiation and/or radioactive materials. At C-AD, GERT ***does not*** allow you entry into Controlled Areas that require personal dosimetry (e.g.: Thermo luminescent Dosimeter - TLD).

In addition to ionizing radiation hazards, experimental areas may contain hazards posed by:

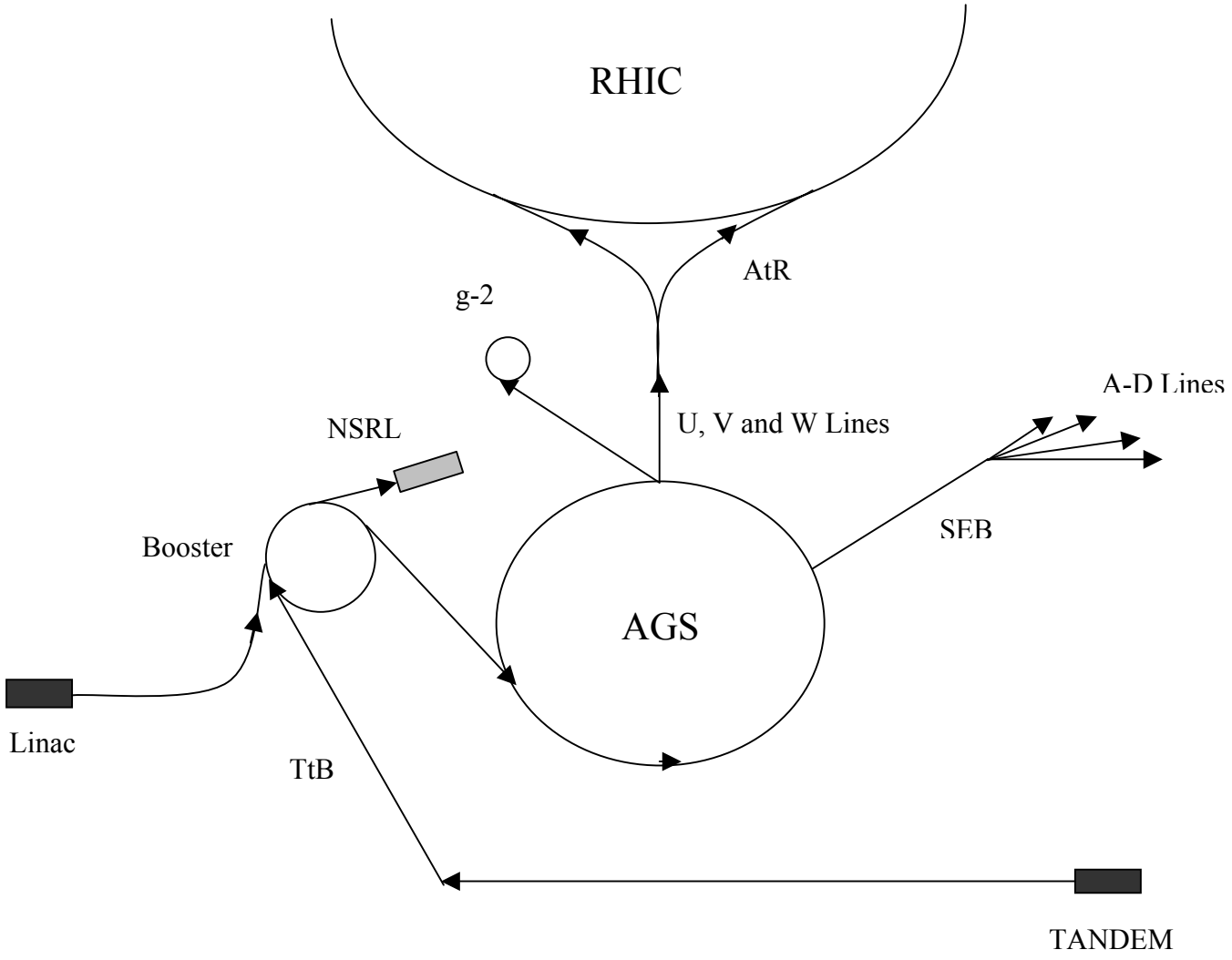
- heavy objects
- mechanical equipment
- overhead cranes
- heights
- high magnetic fields
- lasers
- hot and cold surfaces

- high-voltage and high-current electrical systems
- noise
- oxygen deficiency from release of helium or nitrogen
- radio-frequency (RF) radiation
- contamination and oxygen deficiency from smoke and fire

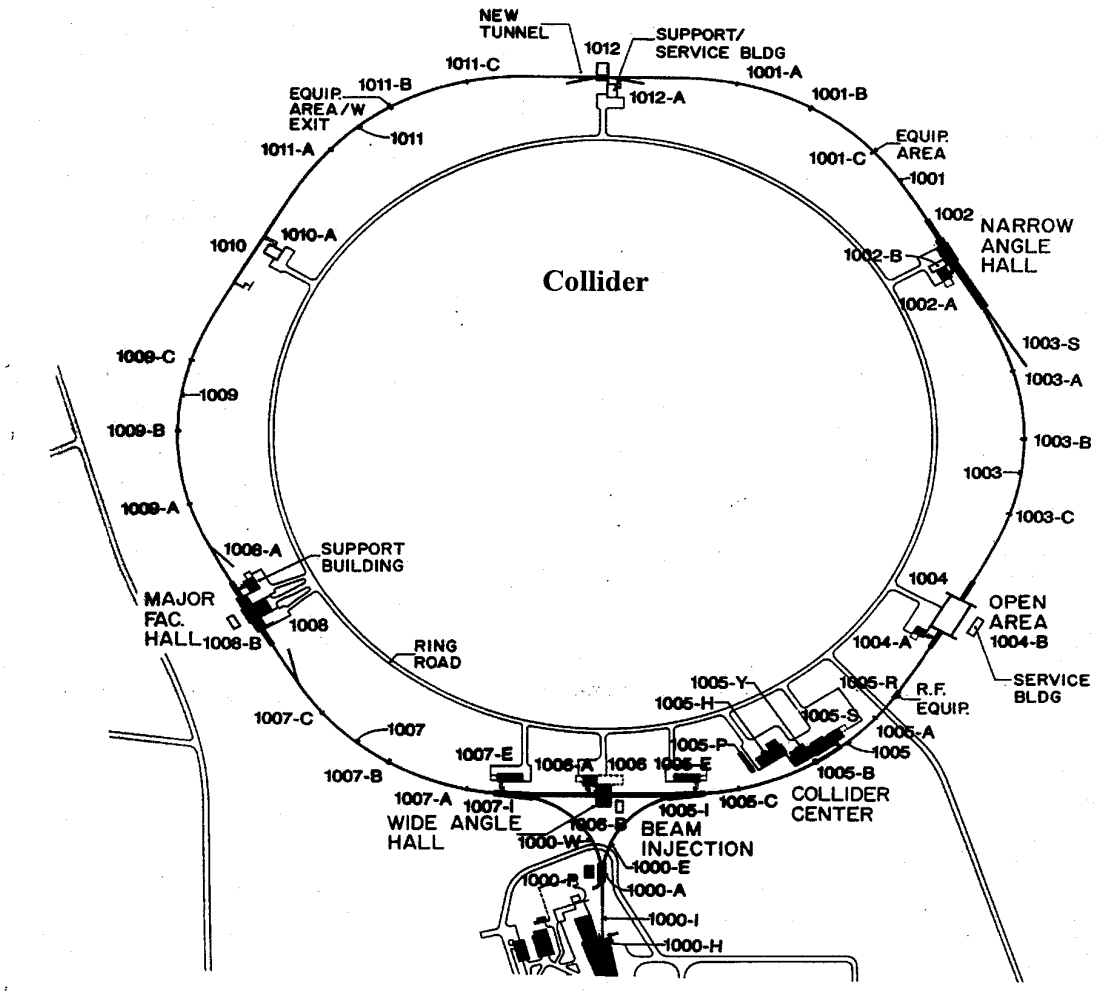
We strive to maintain an excellent safety record in such a complex environment without undue inconvenience to the User. With your help, over the last few years we have significantly reduced fire losses, personnel radiation dose, unusual occurrences, environmental releases and injuries. We can assure the continuity of this safety record only by having the active cooperation of each individual who has access to the experimental areas.

FACILITY DESCRIPTION

The Collider-Accelerator complex includes the Tandem Van De Graaff, Linear Accelerator (LINAC), Alternating Gradient Synchrotron (AGS), and Booster accelerators, which deliver particles to the Relativistic Heavy Ion Collider (RHIC).



COLLIDER RING



The Collider portion of the complex currently has five experiments in operation.

BRAHMS: Located in building 1002, at the 2 O'clock position along the collider.

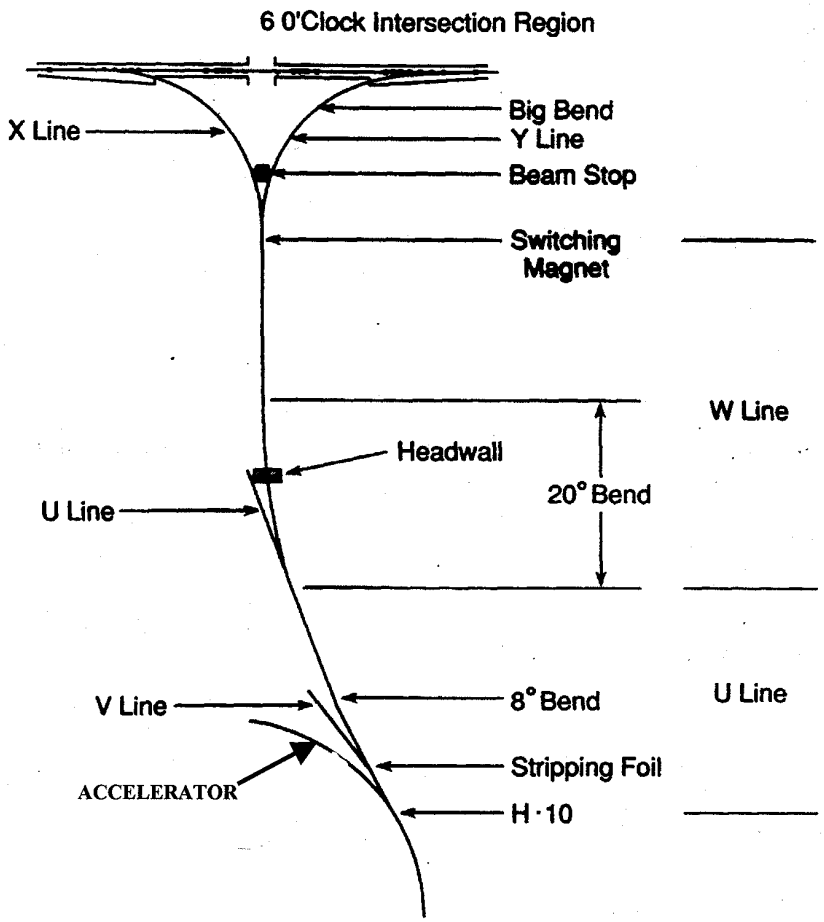
PP2PP: Located at the 2 O'clock position along the collider.

STAR: Located in building 1006, at the 6 O'clock position along the collider.

PHENIX: Located in building 1008, at the 8 O'clock position along the collider.

PHOBOS: Located in building 1010, at the 10 O'clock position along the collider.

ACCELERATOR TO COLLIDER TRANSFER LINE



C-AD CONDUCT OF OPERATIONS

The Collider-Accelerator Department (C-AD) is managed and operated under certain concepts that are part of what is know as Conduct of Operations:

- Definitive lines of authority
- Written procedures exist for most operations
- Use of trained & qualified personnel where required
- Appropriate authorizations and work permits required before beginning a job

During operating periods, responsibility for the safe and reliable operation of the C-AD complex resides with the on-duty Operations Coordinator (OC). The OC is the focal point for all operations related questions or problems and can be reached at phone extension 4662. In an emergency, the OC can make the necessary notifications and arrange for assistance.

You can determine if the accelerators or Collider are in an operating or shutdown status by reading this information on TV monitors located throughout the C-AD complex. Also, control panels at access control gates to each experiment's Intersection Region (IR) will display a RED, YELLOW or GREEN light indicating an access control mode. The access control system will be discussed in more detail later.

During maintenance or shutdown periods, operational-related maintenance must be coordinated through the C-AD Maintenance Work Coordinator and must have the required authorization. Required authorizations are listed in the C-AD Operations Procedure Manual. Lead-personnel are to be appropriately trained. If requested, you must satisfy C-AD requirements for authorization (e.g., working on a system declared as “critical”).

Contacts for RHIC Users include:

Experiment Spokesperson
C-AD Liaison Physicist for the experiment
C-AD Liaison Engineer for the experiment
C-AD Environment Safety & Health Coordinator

RADIATION HAZARDS

PROMPT RADIATION - The most significant source of radiation at the collider is prompt radiation. Prompt radiation occurs while the collider is in operation (when beam is on). Prompt radiation is found in the primary beam line and at the intersection region of each experiment. It is radiation occurring during beam-to-beam collisions or during collision of the beam with other matter; e.g.: beam pipe, beam stop, targets. Primary beam areas have interlocked enclosures designed to prevent personnel access when beam is on. These areas include AGS to RHIC (AtR) Transfer line, U and W lines, and the Collider Tunnel (including the intersecting regions). A fatal dose of radiation may occur as a result of exposure to prompt radiation in an area of primary beam or operating RF (radio frequency) systems. RF Storage and Acceleration Cavities located in the beam line at the 4 o’clock region is an x-ray hazard. **No occupancy is permitted in primary areas when beam is on or RF cavities are enabled**.

RESIDUAL RADIATION - Residual radiation exists as a result of material being activated from the accelerated beam, and exists even after the beam is turned off. Activation occurs from the beam colliding with material directly, or from secondary particles colliding with material or being absorbed into the material. This activation process can occur in the beam stop locations as well as other high interaction or beam loss areas. These areas are posted with radiological signs.

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 approval. Contact your Liaison Physicist, Liaison Engineer or the ESRC Chairperson.

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

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

GENERAL EMPLOYEE RADIATION TRAINING (GERT)

(For access to Controlled Areas at C-AD only)

This training (Collider User Training) includes an approved equivalency for General Employee Radiation Training (GERT).

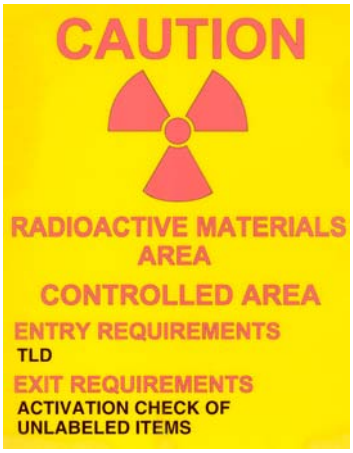
GERT allows you unescorted access into **Controlled Areas**, including **Radioactive Material Areas** within Controlled Areas. At C-AD, this training **does not allow you to enter any area that requires a TLD** (thermo luminescent dosimeter). Such areas include **Controlled Areas** that indicate a **TLD** is required for entry (check postings), **Radiation areas, High Radiation Areas, Airborne Radioactivity Areas, Contamination Areas, and Radiological Buffer Areas**. For example, the Collider tunnel is posted as a Controlled Area with TLD required. The C-AD practice of not allowing entry into a TLD area with just GERT may differ elsewhere at BNL. That is, some departments may issue TLDs, and allow entry into Controlled Areas requiring a TLD, with just GERT. At C-AD however, in order to be issued a TLD and enter a TLD area unescorted, the practice is that you successfully complete BNL's Radworker-1 training, which is a higher-level training than GERT. A reason for this C-AD practice is that there are many posted "Radiation Areas" within the C-AD complex. For entry into posted Radiation Areas, a TLD and Radworker-1 training are required. Logging in to a Radiation Work Permit (RWP) is also required. With many Radiation Areas as well as Controlled Areas throughout the C-A complex, the C-A Department must avoid individuals mistakenly thinking that they may enter Radiation Areas simply because they have been issued and are wearing a TLD. Therefore, we do not issue TLDs without Radworker-1 training.

Maximum Expected Exposure: Individuals trained to the GERT level who are not issued personal dosimetry (e.g.: TLD) are not expected to receive in excess of 100 mrem/year.

RADIOLOGICAL POSTINGS

Read all radiological postings carefully. They are used to alert personnel to radiation and radioactive materials. They indicate requirements for entrance and exit of the area. The following are examples of typical posting encountered at the Collider complex.

During operation, the above posting is displayed at the entrances to RHIC Inner Ring Road. At the successful completion of this course, which includes GERT, you would be permitted past this posting. It indicates Controlled Area. It does not indicate that a TLD is required. During extended shutdown periods, this posting might be removed for convenience. (Note: The Collider Tunnel usually remains posted even during an extended shutdown period and does require a TLD).



Most of the RHIC tunnel is posted as shown above. The posting indicates a Controlled Area with a TLD required for entry. Without a TLD and without Radworker-1 training, you are not permitted into areas posted this way.

Activation Check Requirements: The above posting indicates "Activation Check" under Exit Requirements. Objects that are exposed to primary beam may become radioactive and are to be handled with special care to avoid excessive and unnecessary exposure. No items may be removed from experimental areas, or any areas, posted with "Activation Check" without a Radiological Control Technician (RCT) first checking the item for radioactivity. However, items or material that you bring into an area posted "Activation Check" may be removed without an activation check if the item was never left in the area during beam operation. Check the postings for the area to see if activation checks are required.

PREGNANCY

Because the embryo/fetus is more susceptible to injury from radiation (compared to mature, developed cells), DOE and BNL have a policy which permits the worker to declare that she is pregnant and have the dose received by she and her developing fetus restricted. Any woman working in areas where she could be exposed to radiation or radioactive materials has the option of voluntarily notifying her supervisor in writing that she desires to reduce her radiation dose to protect the embryo/fetus. For a declared pregnant worker, Brookhaven National Laboratory has established an administrative control level of **350** mrem throughout the gestation period, to be received at a maximum rate of **40** millirem/month.

RADIATION LEVELS, AREA NAMES, AND TRAINING REQUIRED

Radiation Level	**Area Name**	**Training Required** (for unescorted access)
< 5 mrem per hour < 100 mrem per year	Controlled Area	GERT And Collider User Training
> 5 mrem per hour < 100 mrem per hour	Radiation Area	Radworker-1 Training And Collider Users Training
> 100 mrem per hour < 50,000 mrem per hour	High Radiation Area	Radworker-1 Training And Other designated C-A Facility-Specific Training

PERSONAL DOSIMETRY (Thermo luminescent Dosimeter Badge - TLD)

Although at C-AD you are not issued a TLD with Collider User Training/GERT, personal dosimetry is discussed here as part of the GERT qualification. The practice at C-AD is that you successfully complete Radworker-1 training to be issued a 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 Facility Support personnel.
- TLDs must be worn on the front of the torso, between the waist and the neck unless directed otherwise by Health Physics personnel.
- Either immediately following a job or at the end of the work shift, return the TLD to the badge board. Be careful to place it in the correct slot. Temporary ("TEMP") badges should not be placed in slots designated for permanent badges. Permanent badge slots have assigned numbers.
- If you leave BNL (employment is terminated or your guest appointment has expired), be sure to leave your TLD on a badge board, or turn your TLD in to Facility Support personnel (x4660 at C-AD) or to the individual who issued you the TLD.
- TLDs issued at BNL should not be worn at another facility and dosimetry issued from another facility should not be worn at BNL. The concern is that your dose should be recorded only once for any time period monitored.
- You must never use someone else's TLD and never lend your TLD for someone else to use. Violation of this policy can result in the most serious disciplinary actions.
- Persons successfully completing this training may be issued a TLD at BNL, although the C-AD practice is that you have Radworker-1 training to be issued a TLD. Trained personnel receive a TLD with a blue or yellow band on the front of the badge. The color alternates monthly. A red band on the front of the badge identifies a visitor TLD. Individuals wearing a visitor TLD require escort in radiologically controlled area requiring dosimetry. If you encounter an unescorted visitor within a TLD area, immediately escort them out of the area. DO NOT REMAIN IN THE AREA AS THEIR ESCORT UNLESS YOU HAVE BEEN PROPERLY APPROVED TO DO SO.
- Never open or tamper with the TLD. If you suspect the TLD has been misused or damaged in any way, (such as having been put through the laundry cycle or been worn during a medical x-ray), you should notify Facility Support personnel (x4660 at C-AD) or the C-AD ESHQ Division Head (x5272, pager 4820).
- If while in a TLD area your TLD is lost, damaged, or contaminated, place your work activities in a safe condition, immediately exit the area and notify Facility Support personnel (x4660 at C-AD) or the C-AD ESHQ Division Head (x5272, pager 4820).
- Report any lost badge immediately.

Regarding the seriousness of proper use of personnel monitoring devices, the following is an excerpt from an article published in ***BNL Radiological News,*** May 2004 :

> Recently there have been several noncompliances concerning the use of thermo luminescent dosimeters (TLDs) at Brookhaven National Laboratory (BNL) (i.e., worker wears another person's TLD, worker does not exchange TLD at month's end but wears it for many months). One of these issues resulted in BNL having to report the noncompliance in the Department of Energy's (DOE) Noncompliance Tracking System (NTS), which is the DOE system for reporting nuclear safety noncompliances. It is important that trained radiological workers follow the requirements for use of personnel monitoring devices.

MEDICAL TESTS THAT MAY IMPACT DOSIMETRY

A common test for evaluating the condition of the human heart is the Thallium (or Technetium) Stress Test, which injects a radioactive dye into the bloodstream. For several days following the test, there remains enough radioactive material in the body to affect the radiation dose being recorded on your TLD. This could also occur if you have had radioactive "seeds" implanted for radiotherapy. It is important that you notify your Facility Support Representative of any medical treatment or diagnostic procedures that you received which involved the use of radioactive materials being placed in your body. Otherwise, your TLD report could incorrectly indicate that you received an occupational dose.

PERSONAL DOSIMETRY RECORDS AND REPORTS

The BNL Personnel Monitoring Group maintains the data collected from TLDs. The Personnel Monitoring Group compiles and distributes personalized dose reports annually to all affected BNL employees. If you as a User require a record of your exposure, you must provide the Personnel Monitoring Group with a written request. A report will be sent to you within 90 days.

BNL's RADIOLOGICAL STOP WORK POLICY

Each individual who has received radiological safety training (GERT or Radworker-1) has the authority and responsibility to stop non-compliant or unsafe radiological work immediately. This policy is commonly known as the Radiological Stop Work Policy. If you believe that a serious deviation from BNL radiological requirements is occurring, inform the workers that you are issuing a Stop-Work order and tell them to stop work. A serious deviation is something that could create the threat of unplanned radiological exposures or releases. In most situations, a formal Stop-Work order is not needed. Supervisors do not need to invoke a Stop-Work Order in exercising their normal responsibilities to monitor work in progress and to ensure proper adherence to BNL practices.

If someone refuses to Stop Work, you should immediately bring this to the attention of your supervisor, or to the C-AD Environment, Safety & Health (ES&H) Coordinator (x4006, pager 453-5940), or to the C-AD ESHQ Division Head (x5272, pager 4820).

If a Radiological Stop Work Order is issued to you, you MUST:

- Stop working on the affected activity as soon as and as safely as possible.
- Place the workspace in a safe condition.

- Report to your supervisor and explain why the Radiological Stop Work Order was issued at your job.

Work is not to resume until safety reviews are performed and the responsible Department Chairperson or equivalent line manager authorizes work to restart.

BNL's RADIOLOGICAL AWARENESS REPORTING (RAR) PROGRAM

The RAR program provides an avenue of communication between daily work activities and management concerning deficiencies in the administration of the Radiological Controls Program. If you have a concern regarding radiological practices or a radiological deficiency, you may initiate a Radiological Awareness Report (RAR):

- Obtain an RAR Form from the C-AD Environmental Safety & Health Coordinator or Facility Support Representative
- Submit the completed RAR Form to your Supervisor

Your supervisor will submit to the RAR Coordinator.

If you have any questions regarding the RAR Program you may contact the RAR Coordinator at extension 4408.

RADIATION EXPOSURE CONTROL

People have always been exposed to radiation from natural sources. We are exposed to this radiation from our environment, from materials inside our bodies, and from certain man made sources such as medical x-rays and other medical procedures. The average radiation dose to a member of the general population in the United States is about 360 mrem/year. This amount is a combination of both natural background and man made sources of radiation. Natural background radiation is the largest contributor (about 300 mrem/year).

C-A EXPOSURE PHILOSOPHY

Radiation Exposure at C-A Must:

- Have a Net Benefit
- Be ***A***s ***L***ow ***A***s ***R***easonably ***A***chievable (***ALARA***)

Once an experiment is configured and enabled, valuable scientific information is obtained. It is difficult to estimate the economic worth of this information. It is assumed that this research has a net benefit. Eating, drinking, or smoking in a radiological area increases the time spent in the area, and correspondingly the dose, without increasing the net benefit. Therefore eating, drinking, and smoking are prohibited in all Radiation and High Radiation areas.

ALARA STRATEGIES

The basic ALARA strategy on the part of the User revolves around reducing dose by the efficient use of time, distance, and shielding. Reduce the time spent in radiological areas, increase the distance from sources of radiation, and use shielding whenever possible. ALARA is also incorporated into design and operations. For example, the access control system at C-A prevents inadvertent entry into high radiation areas (Primary Areas) with beam on. Obey all signs and postings. **Do not enter** any area restricted for radiological purposes unless qualified or escorted.

Our greatest dose reduction at the C-A complex has come by the way of improvement projects. We have improved the reliability of the vacuum system, injection system, and extraction system. The redesign and use of radiation tolerant materials have resulted in fewer repairs of activated equipment, thereby reducing personnel dose incurred for maintenance.

PRICE-ANDERSON AMENDMENTS ACT (PAAA)

It is important to make you aware of the absolute requirement to follow all radiological requirements at C-A 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 radiological 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 radiation 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 radiation 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 nuclear and radiological safety requirements into the "Code of Federal Regulations" (CFR), Title 10 (Energy), Part 835. This is often referred to as: 10 CFR 835, Occupational Radiation Protection.

WARNING

It should be understood that any User who intentionally violates any radiological requirement, regardless of whether the User 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.

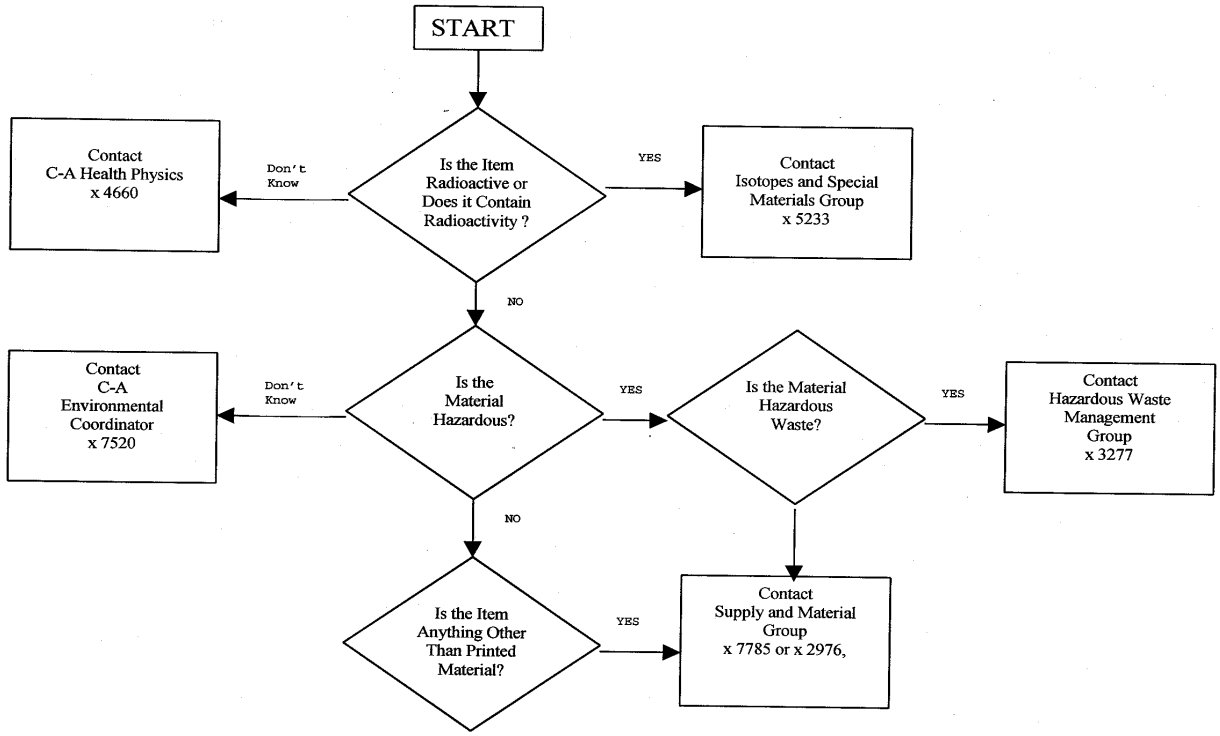
DELIVERIES TO C-A FACILITIES

BNL and C-AD must prevent outside delivery personnel from inadvertently entering areas that they are not qualified to enter while attempting to find the recipient of a package. An untrained delivery person entering an area controlled for radiation protection could receive unnecessary exposure and the occurrence could be a PAAA violation. To prevent this type of incident, the C-A Department requires that, during normal working hours, deliveries for the C-A complex be made to Building 100. Arrangements can be made with the C-AD Main Control Room (MCR) (x4662) for off-hour deliveries. When the delivery is made to Bldg 100 or to the MCR, personnel there will then contact you, the addressee. Under no circumstances are deliveries to be made to other buildings in the C-A complex without approval of the C-A ESHQ Division Head (x5272, pager 4820).

When placing an order, inform vendors to address the package to Bldg 100. In addition, it is important that you inform the vendor to also put your name on the package so that Bldg 100 or MCR personnel have a way to contact you. Packages arriving without a name will be sent back.

SHIPPING OFF SITE

IF YOU ARE SHIPPING MATERIAL FROM THE C-A COMPLEX TO OFF SITE, THEN ASK YOURSELF THESE QUESTIONS.



Particle Accelerator Safety System (PASS)

The Particle Accelerator Safety System (PASS) located within the Collider portion of the C-AD complex is designed to control access to primary beam areas and to detect excessive radiation levels outside shielded areas via radiation monitors (chipmunks). Additionally, the system detects Oxygen Deficiency Hazard (ODH) conditions, activates alarms, activates ventilation equipment, and secures some electrical equipment. The system includes the many locked gates that lead to primary beam areas. The gates control or limit access to the primary beam areas. Entry through the gates is with the use of an access card or key. PASS gate entries require **one card or key for one person only! Each person must enter with his or her own card or key.** More than one person entering under one card or key is considered a serious violation of procedure, and is subject to disciplinary action.

ENTRY MODES AND STATUS INDICATORS

There are 3 basic entry modes that the facility (or a particular gate) may be in:

(RED) **ACCESS PROHIBITED** Mode

↓

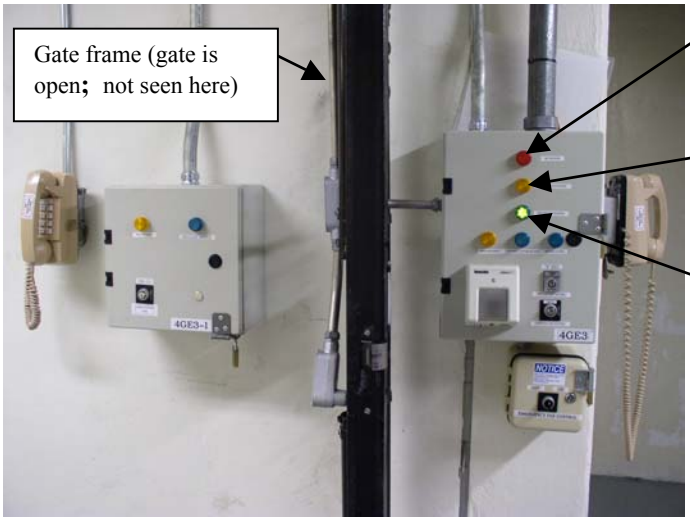
(YELLOW) **CONTROLLED ACCESS** Mode

↓

(GREEN) **RESTRICTED ACCESS** Mode *(least restrictive)*

ENTRY and EXIT CONTROL PANELS

Control panels are located at entrances and exits of the PASS gates. Entry through the gates require use of an Access Card (during Restricted Access Mode) or metal Key (during Controlled Access Mode). A system of lights on these boxes indicates the machine's operational access status. A typical gate is shown below, although Experimenters/Users usually enter and exit the gate which leads to their own experiment's Intersection Region (IR).



Typical Entry and Exit Gate Panels at the Collider

GREEN LIGHT - RESTRICTED ACCESS

To enter place access card on card reader, get green light on reader, open door. To exit, turn knob to open door (card not required to exit).

Card Reader:

Access Card:

YELLOW LIGHT - CONTROLLED ACCESS

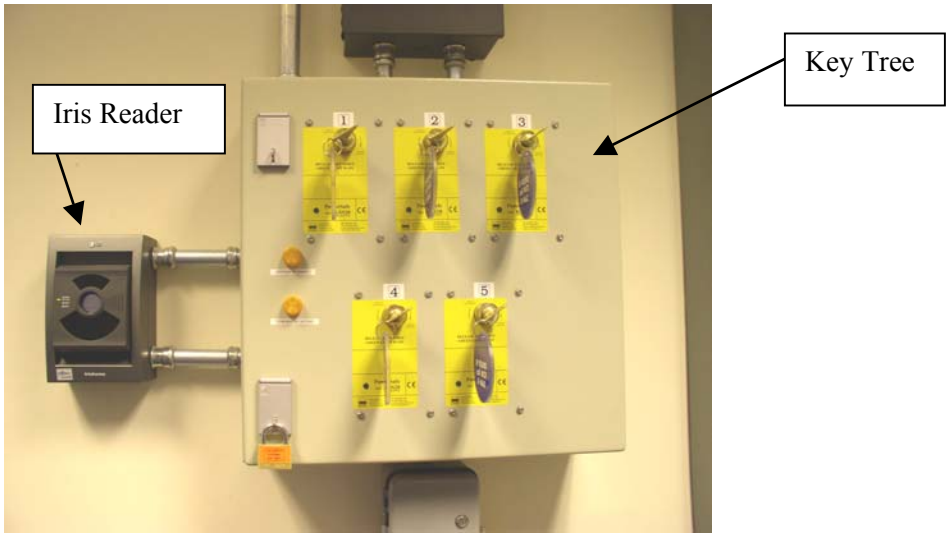
To enter, confirm accessibility to the area with the experiment Shift Leader. For IR entry, obtain a key from the key tree for your experiment. Key trees are located at each experiment. In order to obtain a key from the key tree, you must first have your iris registered. To register your iris, contact your Experiment Spokesperson, Liaison Physicist or supervisor. The C-A Department ESHQ Division performs iris registrations. During Controlled Access Mode, each individual entering the area is being accounted for; unlike during Restricted Access. The procedure for entry into the IR gate during Controlled Access Mode is described below.

RED LIGHT – ACCESS PROHIBITED

No access is allowed. Beam is already on or is imminent.

IR Entry procedure during ***Controlled Access*** Mode

Note: You must first have your iris registered. To have your iris registered, contact your Experiment Spokesperson, Liaison Physicist or supervisor.



1. **Look into the iris reader located at your experiment key tree location with either eye and center your eye in the box outline on the mirror.**

   Stand so that your eye is approximately 3 to 9 inches away.

   Notes: The iris reader will speak instruction back to you if you are too far or to close.

   You may adjust the tilt of the iris reader to suit your height.

2. **Place your right hand on the next sequential key in the key tree.**

   Note: Keys must be removed in sequential order.

   When accepted, the iris reader voice will say "Identification Completed."

   Remove the key from the key tree by turning the key to the left and pulling.

   Note: You have about 2 seconds to remove a key after being identified by the iris reader.

3. **Take the key to the control panel at the gate to the Intersection Region (IR) of your experiment.**

   Observe that the *YELLOW* Controlled Access light is on; 2nd light from the top.

4. **Place the key in the gate key switch on the control panel.**

5. **Contact the Main Control Room (MCR). A phone or intercom is located at the gate. Identify yourself to the MCR operator by giving your name and ask for a release of the door.**

> Note: The MCR operator is observing you and the gate area remotely by camera.

6. **Turn the key with simultaneous release from MCR.**

7. **Remove the key, open the gate, and take the key with you into the Intersection Region (IR).**

> **Caution:** **Each person** entering must obtain a key from the key tree. More than one person entering under one key is a serious violation of procedure, and is subject to disciplinary action.

8. **To leave the area, contact the Main Control Room (MCR) using the phone (or intercom) located on the IR side of the gate and ask the operator for a release of the gate.**

> Note: Failure to contact the MCR will require the MCR to re-sweep the area which will result in unnecessary delay.

9. **Open the gate and exit.**

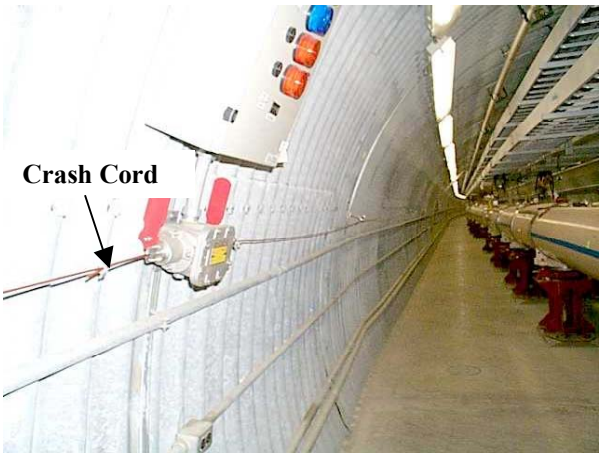
> **Caution:** **In an emergency, open the doors and exit without waiting for a release from MCR.**

10. **Return the key to any empty key switch in the key tree and lock in the key by turning it to the right.**

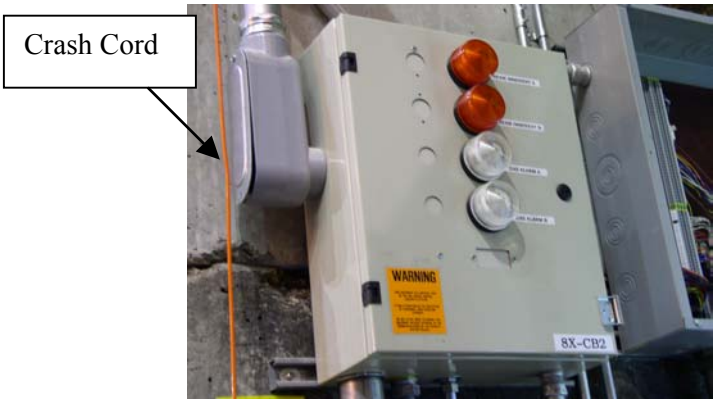
> Note: Keys do not have to be returned to their original key switch location.

11. **Stand in front of the iris reader and look into the camera with either eye to log out. You are logged out when the camera voice says "Identification Completed."**

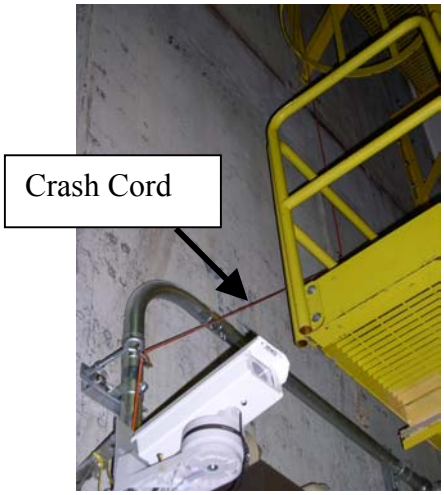
BEAM IMMINENT ALARM
&
CRASH CORDS



Crash Cord and Lights in the Collider Tunnel



Example of Crash Cord in IR



Example of crash cord in IR

In the Intersecting Regions (IRs) of the Collider experiments, in Experimental Halls, and in the Collider Tunnel, there are Orange Crash Cords and Orange Strobe Lights. If you are in any of these areas and an orange strobe light goes on and an audible alarm is heard, this is a signal that beam is imminent. If you observe the visual and audible warning signals you must pull a crash cord or open any exit/entry gate from the inside. **Do not panic**, you have time, 60 seconds minimum before beam is on. Exit the area. Pulling the crash cord or opening the gate will interrupt normal operations and prevent beam from entering the area. After exiting the area, call the MCR (x4662) and inform them of the incident.

Do not tamper with crash cords. Do not hang tools or clothing on the crash cords, this may stretch them out causing reset errors. Do not block access gates open. Any modifications to the PASS system (such as entry gates) must be pre-approved by the C-A Access Controls Group.

GOLDEN RULES FOR RADIOLOGICAL AREAS AT C-A

- Do not climb over or defeat barriers
- Do not ignore signs, labels, alarms or warning tags

For all postings that indicate a TLD is required, Users must take BNL's Radiation Worker I Training Course, and obtain, and be wearing, a TLD *prior* to entry into these areas.

RADIATION SOURCES

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 from the source. This is because most sources are point-like objects. Federal rules define sealed sources as any radioactive item manufactured for the sole purpose of using the emitted radiation. A common example of a sealed source is an instrument calibration source. If you are not sure about the definition of a sealed source, then contact the C-A Health Physics Office (x4660) in order to make a determination regarding the rules.

When not in use, sources should be stored in shielded containers. Many experimental areas have two or more source boxes, like the one shown above. If you are using a source in your work, then the following rules apply, even if you obtained the source from another BNL Department or Division:

- Contact the C-A Source Custodian (x5636).
- Have all sources inventoried and leak-checked every six months by the C-A Health Physics Office (x4660).
- Notify BNL's Isotopes and Special Materials Group prior to shipping a source to or from BNL. Contact I&SM Group at 631-344-5233.
- Complete the ***Sealed Radiation Source Inventory Form*** and keep it with the source.
- The Health Physics Office must be contacted if sources are to be relocated.

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

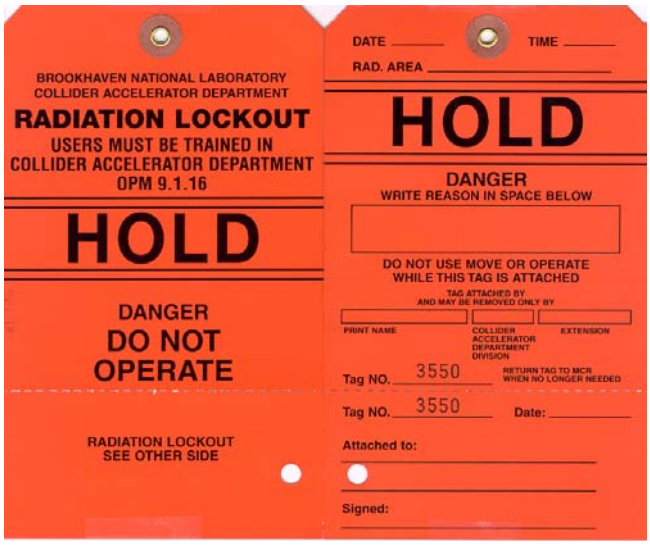
LOCK OUT / TAG OUT (LOTO)

Lockout/Tagout (LOTO) is used at the Laboratory for personnel safety for energy sources. It is recognized by the presence of a red tag or a lock, and it requires that you obey specific OSHA requirements. In some cases, the equipment cannot be locked and only the red tag is used. In most cases, however, LOTO boots or other commercially available locking devices can be added to the device to enable complete LOTO. Contact the C-A ES&H Coordinator for more information (x4006, page 453-5940).

To prevent accidental radiation exposure, electrical shock or other hazards from different sources of energy, the LOTO is only to be removed by the individual who attached it. However, if the individual who attached the LOTO is not available, a committee of three employees must be formed, and the membership of the committee is designated in the C-A Operations Procedures Manual (OPM). These persons will be familiar with the area or equipment under the LOTO and they shall determine if it is safe to remove the red tag and lock. Contact the MCR (x4662) or the C-A ES&H Coordinator (x4006, page 453-5940) if you need to remove someone else's LOTO. A similar procedure is used for Radiation Safety (RS) LOTO.

All personnel who must work on electrical circuits that are powered and are controlled by circuit breakers, disconnect switches and/or fuses, must LOTO the circuits. OSHA, BNL and C-A require that all workers performing these tasks be trained in LOTO. If you or your co-workers fall into this category of needing to perform LOTO, then contact the C-A Training Manager (x7343). This Collider User Training alone does not alone allow you to place or remove locks or tags.

RADIATION SAFETY LOCK OUT / TAG OUT (RS LOTO)

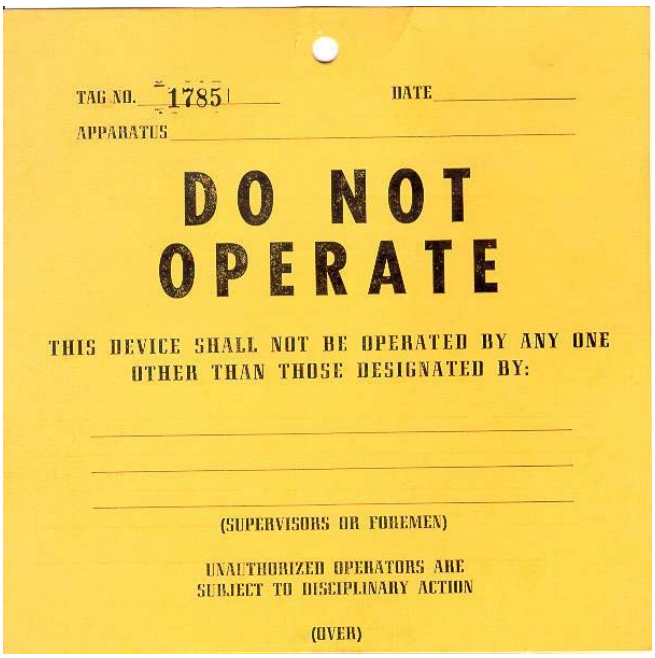


Liaison Physicists, Liaison Engineers, Access Controls Group staff, Operations Coordinators (OC), members of the Radiation Safety Committee, and certain other personnel perform RS LOTO. They must follow a specific procedure in order to lock out and tag out equipment or beam lines for radiation protection. Equipment or beam lines are generally locked out during barrier modifications or barrier removals, or whenever the PASS system alone does not provide the required protection. This lockout is required in order to limit beam parameters such as polarity and intensity, or whenever a beam line is not authorized to operate. **DO NOT** alter or otherwise tamper with equipment that bears the RS LOTO tag.

YELLOW TAGS

Used for EQUIPMENT PROTECTION or to prevent PROGRAMMATIC DISRUPTION.

Yellow "Do Not Operate" and "Caution" Tags at C-AD are used to protect machines or apparatus/systems. If personnel protection is involved, LOTO (Red Tag) is used. Do not operate equipment or a device, such as a valve, breaker, switch, etc., that has a yellow tag attached unless properly authorized to do so. Do not remove a Yellow Tag unless properly authorized to do so.



CHIPMUNKS AND RADIATION SURVEYS

Radiation monitor - Chipmunks

During a running period, radiation surveys are updated periodically, and continuous area monitoring is performed by instruments called Chipmunks, most of which alarm in the Main Control Room. During shutdowns, surveys are done initially, and whenever a job-specific RWP (Radiation Work Permit) is used. Records of the surveys are maintained by the C-AD Health Physics Office. Survey data is normally attached to the permits and copies are maintained at the job site.

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

Retrospective exposure rates for any area of interest can be determined by the staff at the C-AD Health Physics Office.

The Chipmunk is set up like a street light with red, yellow and green indicators. A chipmunk will display a red blinking light for radiation levels greater than 20 mrem/h, and a yellow blinking light for levels greater than 2 mrem/hr. Normally, chipmunks operate in the green range indicating nominal radiation levels. If you observe a chipmunk indicating in the yellow or red range, leave the immediate area, notify your collaborators to leave the immediate area, and then contact the Main Control Room (x4226) for instructions. Note: In some cases, when running high-energy protons, it may be expected that a chipmunk is indicating slightly into the yellow near a target room.

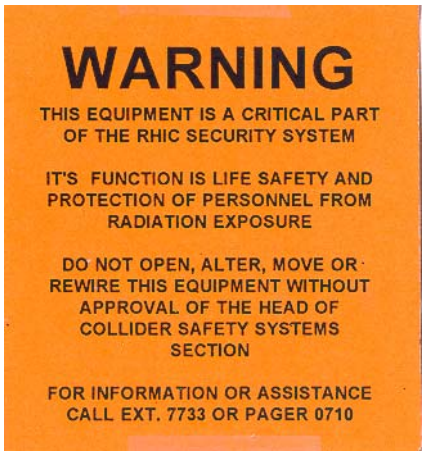
There are over 100 chipmunk-monitoring devices in use at this time. They have pre-designated alarm levels established by the Radiation Safety Committee. Main Control Room Operators are trained to respond to alarms and investigate the cause, even if it means interrupting the physics program. Do not move or tamper with chipmunks.

SECURITY SYSTEM ORANGE TAGS

The devices sensed by the security system (PASS) must remain correctly connected. In order to help ensure that personnel do not disconnect or alter these devices without following the approved procedure, the Access Controls Group will identify devices with an **orange warning tag**. In the experimental areas, these tags alert personnel that the device is critical to safety and the operation of the PASS System. **Do not move** these devices since relocation will compromise their effectiveness. Contact the Main Control Room if these devices are inhibiting your work.

- Program disruption and/or electrical shock may occur by overlooking an orange warning tag.

- Tags and signs are often placed only on the front of equipment. Look at the front of equipment



RADIATION SAFETY SERVICES

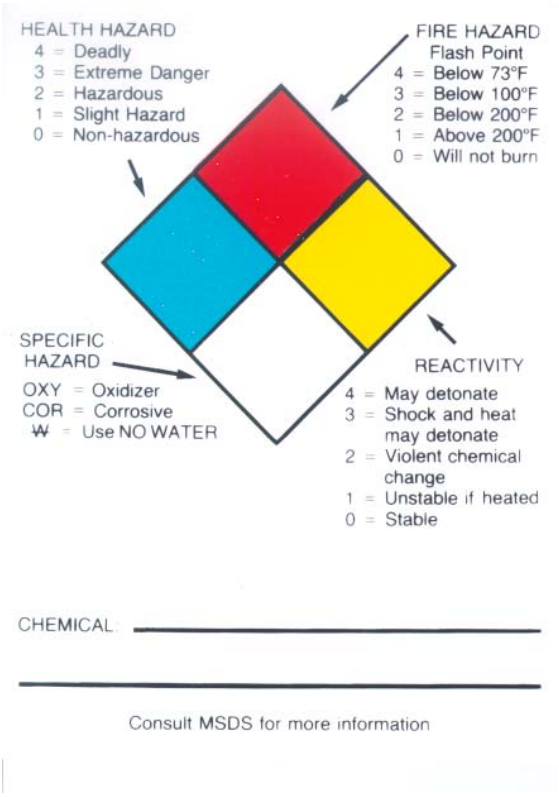
- Contact Health Physics Office; Telephone x4660

The Radiological Control Division provides the C-A Department with radiation safety services. They provide dose records, radiation surveys, Radiological Control Technician (RCT) coverage for high-dose jobs, and review of RWPs for ALARA. They also assist in interpreting abnormal radiation levels.

During running periods, RCT coverage is provided on all shifts. During shutdown, services are provided from 8:30 a.m. to 4:30 p.m., Monday through Friday. Assistance is obtained by contacting the Health Physics Office (x4660), or by contacting the C-A MCR (x4662).

Special shifts for RCTs may be pre-assigned allowing for specific round-the-clock coverage when needed during a shutdown.

INFORMATION ON HAZARDS, YOUR RIGHT TO KNOW



You have the right to know about potential health and safety hazards in your workplace, and whenever the potential for exposure to hazardous materials exists. You will be provided with specific safety and health information by the ES&H Coordinator. Contact the ES&H Coordinator at x4006, pager 453-5940. The ES&H Coordinator can provide you with information on the Laboratory's policy on hazard information, and on how to obtain and interpret Material Safety Data Sheets (MSDS). Some of the information that can be found on an MSDS is the 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.

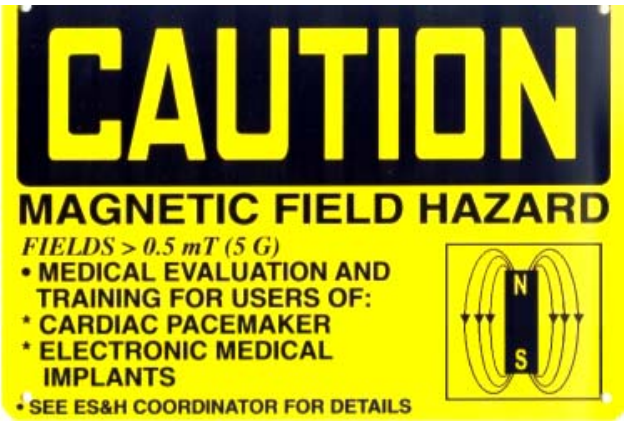
National Fire Protection Association (NFPA) diamonds appear on containers, and various structures that contain hazardous materials, indicating the degree of hazard for the materials.

The ES&H Coordinator can also provide information on how to select and use protective equipment, and explain the labeling system used on chemical containers.

CHEMICAL SAFETY

For your safety, purchased chemicals are inventoried by the Laboratory prior to delivery for end use. If you bring un-inventoried chemicals on site you must contact the ES&H Coordinator (x4006, pager 453-5940) to have these chemicals inventoried and bar coded prior to use.

MAGNETIC SAFETY



Where magnetic fields are present, a 5 Gauss (0.5 milli Tesla) limit is posted on doors of buildings, and on warning signs in the Collider tunnel.

Use extreme caution with iron and steel objects when working around magnets with large gaps (e.g., spectrometer magnets). Be sure magnets are not energized and the area is cleared of ferrous objects. Remember that the field may be effective at a surprisingly long distance. Follow all magnetic safety plans specific to your experiment.

East Face of the STAR Magnet
Orange barrier denotes 500 Gauss limit.

LASER SAFETY

Lasers must be registered with the BNL Laser Safety Officer. This includes higher hazard class lasers (Classes IIIb and IV) as well as lower hazard class lasers (Classes II and IIIa). Examples of Class II or IIIa lasers include alignment lasers, and devices incorporating pointing lasers.

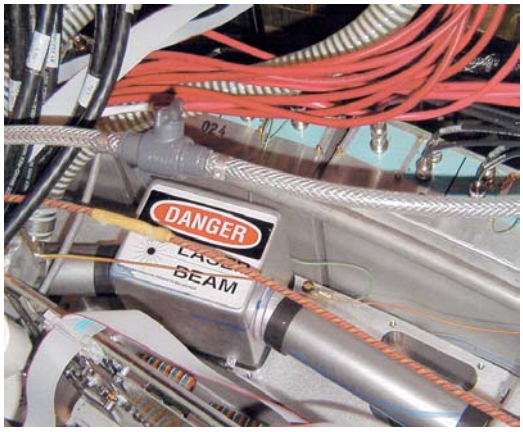
Use of higher class lasers, Classes IIIb and IV, requires additional Laboratory training as well as completion of a Laboratory Standard Operating Procedure (SOP).

Classes II and IIIa lasers require a permit.

Make sure you are aware of the safety requirements established for lasers in your area.

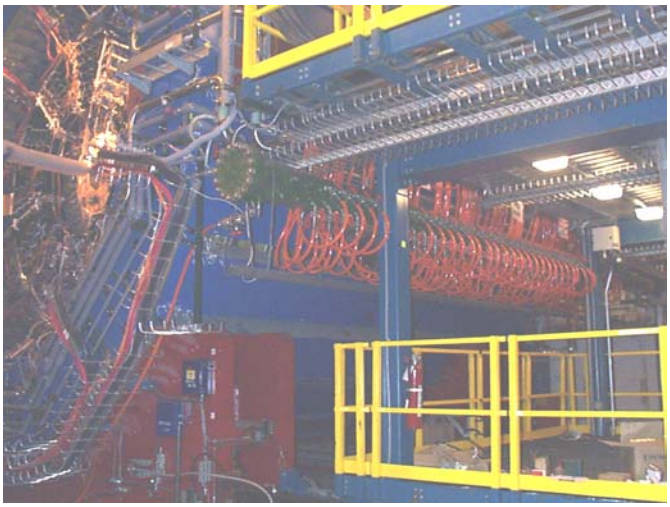
If you have questions regarding lasers, you may contact the C-AD Laser Coordinator, Asher Etkin, on x4006

Lasers located at STAR



MAGNET WATER COOLING

Magnet cooling water systems may incorporate electrical buses. The water systems operate under pressure and require special training to work on. Depending upon the location in the C-A complex, some magnet cooling water systems may have a radiation field associated with them. These are clearly labeled and should not be handled without proper training and authorization.



STAR Magnet Cooling System

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, it may not be practical to eliminate the hazards completely and protective clothing and/or equipment is required for safety. Plan your work in advance. Consider whether PPE may be needed. Contact the C-A ES&H Coordinator (x4006, pager 453-5940) for reviews and approvals whenever PPE is to be used.

HARDHAT POLICY

You area required to wear a hardhat:

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

SAFE FOOTWEAR

You must wear footwear that is appropriate for the area and activities in which you are involved. The footwear should fully enclose the foot and provide stable footing for walking on uneven surfaces. ***Safety shoes are required where there is a potential hazard from falling, rolling or piercing objects or heavy objects are handled***.

It is especially important to remember this during warm weather when people might otherwise choose footwear more for comfort rather than safety.

FRAGILE EQUIPMENT

Many experiments at the C-A complex employ devices and equipment that are fragile such as vacuum windows, scintillation detectors, prototype detectors, electronic cards, connectors and cables. All of these devices require proper training and authorization prior to performing work on them. All Collider experiments have beryllium beam pipes installed. This material is fragile, and toxic. Protection is provided to prevent physical damage.

Care is always required in experimental areas to prevent damage to fragile components of the experiment.

FLASH HAZARD

A flash hazard is present when the potential exists for electrical equipment to arc, producing a shock hazard, possible sparks and molten metal spray. This can occur in situations were electronic components and connections are exposed during testing. If a conductive tool is dropped into these areas a flash event may occur. Care is required in these areas to prevent any inadvertent electrical contact.

GREEN WORK PERMIT AND IN-HOUSE WORK PLANNING AND SCREENING AT C-A

WORK PERMIT #

STANDING WORK PERMIT

Hazard Analysis

Work Controls

Training Requirements

All work at C-A must be screened for ES&H hazards. The Work Permit (Green Form) contains a large number of ES&H items to consider and is used as a screening tool. The work planner determines the hazard category of the work to be done: Low, Moderate or High Hazard. For all Moderate and High Hazard jobs, it is required that the Work Permit be completed ("Enhanced Work Planning"). The hazard categories are generally described as follows:

Low-Hazard Work is work requiring the attention of the worker to prevent minor injury. Failure to correctly perform low-hazard work would not damage equipment or structures or release potentially hazardous materials to the environment, except as a result of gross negligence.

Moderate-Hazard Work: Work requiring coordinated actions to prevent injury to personnel, minor damage to equipment or structures, or release of hazardous materials to the on-site environment.

High-Hazard Work: Work requiring coordinated actions to prevent serious injury to personnel, significant damage to equipment or structures, or releases of reportable quantities of potentially hazardous materials to the off-site environment.

Additional details and specific requirements for work planning for experiments and Users are located in C-A OPM 2.29, " C-A Procedure for Enhanced Work Planning for Experimenters." **Users are required to sign the Low Hazard - Skill of the Craft Signoff Sheet** which indicates they have read and understood the Skill of The Craft work planning incorporated at their experiment. This work planning document delineates the type of "low hazard" work, with its associated hazards, that Users may perform at an experiment. It is the Experimental Spokesperson's responsibility to ensure that all work is planned in accordance with the intent of the C-A work planning policy.

ELECTRICAL SAFETY TRAINING

If you work on electrical circuits that are powered through circuit breakers, disconnect switches and/or fuses, then you must LOTO the circuits. OSHA, BNL and C-A require that all workers performing these tasks be BNL trained.

C-AD/BNL has three courses covering electrical safety that you may be required to take and pass:

- Electrical Safety
- Lockout/Tagout and
- Working Hot

Working Hot training (as well as Electrical Safety and Lockout/Tagout training) are required if you plan to work with:

- Voltages greater than ***50 Volts AC*** or ***50 Volts DC***

and

- Systems with greater than ***10 ma*** of available current or capable of releasing ***10 joules*** or more of energy instantaneously

If you have questions regarding the electrical safety training requirement for your specific situation, then please contact the C-A ESH Coordinator (x4006, pager 453-5940).

REMOVING DAMAGED EQUIPMENT FROM SERVICE

If any equipment presents an immediate hazard that could reasonably be expected to cause serious injury or environmental harm, then you must remove it from service (e.g., broken ladders, frayed slings, defective power cords, leaking tanks).

ACCOUNTABILITY FOR FOLLOWING THE RULES

You are responsible for following C-AD rules and procedures for which you have been trained. If you cannot follow the rules and procedures in order to perform your work, you must have the rule or procedure officially changed to suit what is needed. Rules and procedures shall be followed even if staffing levels are low. Do not violate safety requirements to get the job done.

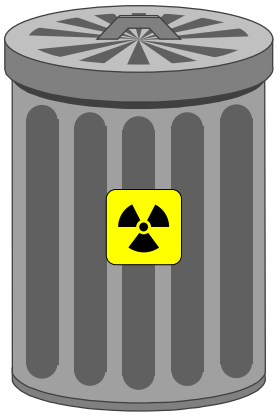
This policy applies to C-AD staff as well as Users and will be enforced everywhere.

WASTE DISPOSAL

CAUTION:

Improper disposal of radioactive or hazardous waste may result in fines, criminal prosecution, and facility shutdown. Contact the C-A Environmental Coordinator (x7520) for information on any waste. The C-A Environmental Coordinator is familiar with rules, permits, authorizations and analysis requirements necessary for proper disposal.

Contact the Environmental Compliance Representative (ECR - x2905) prior to establishing any airborne, liquid or solid radioactive- or hazardous-waste-stream.



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 the States receiving waste from C-A must also be followed.

Information on proper disposal of waste is contained in BNL's Standards Based Management System (SBMS) and in C-AD procedures (Operations Procedures Manual (OPM) Chapter 8).

All chemical containers must be marked as to contents, even water containers. All bags or packages of waste must be marked indicating the contents and where the waste came from.

- Do not place clean materials in radioactive waste bins
- Do not place radioactive materials in the green 3-yard bins used for clean waste
- Substitute reusable materials where possible
- Use minimum quantities of materials
- Segregate wastes
- Do not leave unnecessary items in primary areas

Each person is responsible to ensure that they handle, accumulate or dispose of waste by using adequate and proper controls and documentation. Waste generators at the C-A must check all waste to ensure that it is not radioactive. Generators of hazardous or radioactive waste at the C-A should minimize the amount of waste they generate by substituting re-usable materials where possible, using minimum quantities of materials, and segregating different wastes to allow for reclamation.

Hazardous waste is subject to time limits and volume limits that must be strictly adhered to. Generally, accumulation of more than 55 gallons at a satellite accumulation area is not allowed. Once the waste is moved to the C-A Hazardous Waste Trailer, a 90-day clock starts. The waste must leave the C-A complex within this 90-day period. Containers must be appropriate for the type of waste being collected and be dated and labeled. Your cooperation in this area is important in order to maintain C-A's good reputation in the surrounding community.

Activated lead is an example of mixed waste. It is both hazardous and radioactive. Do not put mixed waste in radioactive waste cans. Another example of mixed waste is activated oil.

Do not throw clean metals into waste cans used for ordinary clean waste. Non-radioactive metals should be re-cycled. Metals in our clean waste stream are a problem since the Brookhaven Town Landfill will refuse BNL's clean waste if they find metal in it.

Question: You need to throw out empty cans of a liquid chemical that you used to clean equipment. You realize the liquid itself may require special handling, but the containers are dry. What do you do?

Answer: Initially treat the container as hazardous waste and contact the C-A Environmental Coordinator (x7520) to learn the proper disposal technique.

SPILLS

The C-A Department is required to report spills; internally, externally, or BOTH. C-AD must report to outside (external) agencies on spills that impact the environment. Reporting must be made within certain time constraints so it is important that you notify appropriate people of a spill promptly. Even minor events, such as spilling any amount of oil in an outdoor area, require reporting. The rules are such that we must ***consider*** reporting spills of any type or size.
For any spill, notify your Experimental Spokesperson and/or the Liaison Physicist.

If you spill any hazardous or industrial material outdoors on the ground, or anywhere inside and the spill is beyond your control, call x2222 or 911 to report the spill. Then call the C-AD Main Control Room (x4662), the C-AD ESHQ Division Head (x5272) or the C-AD Environmental Coordinator (x7520) as soon as possible. Do not leave a message on an answering machine as notification.

When reporting a spill, give your name and information on the spill location, type of material and approximate amount.

For further information on spills, see BNL's SBMS subject Area "Spill Response".

COMPRESSED GAS SAFETY

Note: If you will be working with compressed gas cylinders, complete BNL web-based course Compressed Gas Safety (TQ-COMPGAS1)

All compressed gases are hazardous due to high pressure. Because of the different hazards associated with different gases, it's important that cylinders be properly labeled. When a cylinder is delivered to the gas warehouse, a laboratory, or a job site, it should have:

- **content identification,**
- **DOT label**, and
- **a valve protection cap**.

UNDER NO CIRCUMSTANCE should the means of identification be removed from a cylinder. The valve protection cap should remain in place until the user has secured the cylinder to a fixed support at the point of use and is ready to attach a pressure regulator to withdraw the contents.

The personnel at the BNL Gas Warehouse will attach a Cylinder Status Tag on the cylinder when it is received. Tear off the bottom of the Cylinder Status Tag and write name of assigned user on tag indicating the cylinder is in use.

GENERAL RULES FOR CYLINDER HANDLING

- 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.

COMPRESSED GAS CYLINDER SAFE STORAGE

- Storage areas should be dry, cool, and well ventilated, and where practical, fire resistant.
- Gases of different types are to be grouped by type and non-compatible types should be separated. Flammable gases shall not be stored with oxidizing gases.
- Cylinder storage areas are to be prominently posted with the types of gases stored.
- Charged and empty cylinders should be stored separately.
- Cylinders should be arranged so that old stock can be removed first with a minimum handling of other cylinders.
- Cylinders should not be stored at temperatures above 125 ^{0}F, (51^0 C) or near sources of heat.
- Cylinders should not be stored near highly flammable or combustible materials.
- When cylinders are being moved on a cylinder cart, they must be secured to the cart.

FIRE OR OTHER EMERGENCY

In your work area, make a mental note of the following:

- Exits
- Fire Alarm Pull Boxes
- Crash buttons
- Crash cords
- Emergency exhaust, if any
- Telephones

Question: You need immediate help in an emergency. What do you do?

Answer: Pull a fire alarm box (if there is one in the area) <u>and</u> call x2222 or x911. This is the preferred method for contacting the emergency response team.

Fire Alarm Pull Box

Question: There is a fire near the tanks on your acetylene-welding unit. What do you do?

Answer: Warn others and evacuate the building.

In any emergency, you may (and are encouraged to) pull a fire alarm box; it does not have to be a fire. Also, call 911 or 2222. Fire alarm boxes are located throughout the complex, at the experimental halls, and in the Collider tunnel. This is the best method to simultaneously alert the C-A Main Control Room (MCR) and the BNL Fire/Rescue Group. Pulling a fire alarm box and telephoning 911 or 2222 brings the Fire/Rescue Group to your specific alarm-box location within a couple minutes, and appropriate additional personnel can be summoned quickly.

The accelerator tunnels are restricted spaces. If fire should break out, then smoke could quickly impair visibility, and asphyxiation from contained gases can occur.

In the Collider tunnel, vertical and horizontal emergency exits alternate and are located throughout the tunnel. At the experimental intersection regions, there are multiple horizontal exits. All exits go to the inner ring road.

Once outside a smoky area, report to the Local Emergency Coordinator (LEC) or the Department Emergency Coordinator (DEC) if they are present. They will be wearing baseball-like caps marked DEC or LEC. Do not chat with the Fire Captain or other emergency response personnel in the area. Obey the directions of the Fire Captain, DEC or LEC.

C-A ALARM SIGNALS

You must obey the emergency signals. For example, if you are inside a C-A primary area:

RESPONSE TO FIRE ALARMS

If you hear a Fire Alarm Bell evacuate the area after placing equipment in a safe operating mode, and go to the Outdoor Assembly Area. A fire alarm bell has a metal "clanging" sound. Main Control Room (MCR) personnel must remain on station if they have emergency duties, but will evacuate during imminent danger situations. Indoor and Outdoor Assembly Areas are posted on building entrance doors.

Obey the directions of the BNL Fire Captain, the Department Emergency Coordinator (DEC) or the Local Emergency Coordinator (LEC).

RESPONSE TO FLAMMABLE/EXPLOSIVE GAS ALARMS

If you hear a two-tone horn in the collider experimental areas complex accompanied by a yellow strobe, evacuate immediately and report to the Outdoor Assembly Area.

For example, the STAR and PHENIX experiments use flammable/explosive gas.

BNL SITE SIRENS

- If you hear a continuous site-wide siren for five minutes, go to the Indoor Assembly Area. Assembly areas are posted on building entrance doors.
- If you hear a pulsating site-wide siren, then evacuate the BNL site.

The site evacuation plan covers C-A as well as other facilities on-site.

The site sirens are tested each Monday at noon. You will hear the sirens being tested.

FIRE SAFETY

The fire safety program at BNL emphasizes prevention through the design of buildings and automatic protection. If you suspect a fire, pull the fire alarm box and telephone 2222 or 911, Fire Rescue Group. Warn everyone 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 size fires. If you have any doubts, let firefighters handle the situation.

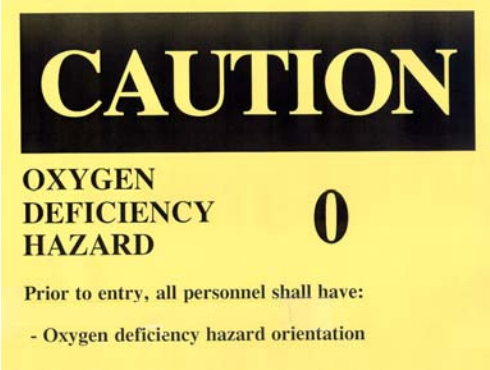
ACTIONS FOLLOWING AN INJURY/ILLNESS

If there is an emergency involving an injury or an illness such as a heart attack, then pull the fire alarm box and call x2222 or x911. If you are injured but do not require emergency attention, then report as soon as possible to the BNL Occupational Medicine Clinic (OMC), which is located in Building 490. Your supervisor or Liaison Physicist should accompany you. If your supervisor is not available, you should call upon another member of supervision or management in your Department or Division to go with you. In most circumstances, it is expected that you report to the Clinic immediately after the injury. If this is not possible, you are required to notify the Clinic immediately and report to the Clinic with your supervisor, or alternate member of management, before the end of the work shift in which the injury occurred, or at the start of your next work-shift. If you fail to notify and report to the Clinic as required, any resulting missed work may be considered unauthorized leave and will be ineligible for sick leave.

ELECRICAL POWER FAILURE - Be Prepared

In the event of an electrical power failure, the accelerator tunnels and experimental areas could become pitch black if emergency back-up power fails to turn on. It is strongly recommended that you bring a flashlight with you if you enter any of these areas.

OXYGEN DEFICIENCY HAZARDS



This Collider User Training includes an equivalency for BNL's ODH Class 0 training.

What is oxygen deficiency?

Normal atmospheric content is 20.9% oxygen, 78% nitrogen, and 1% argon. Oxygen deficiency is defined as less than 19.5 % oxygen. This happens when air in an enclosed space is displaced by another gas.

What causes oxygen deficiency?

Cryogenic systems use large amounts of helium and nitrogen. Both liquids expand about 700-800 times when released into air. This could happen quickly with a major release as a result of catastrophic failure. In a major release, one might see a rapidly expanding white cloud and hear a "whooshing " sound. The leak could also be slow, invisible and silent. Both helium and nitrogen are colorless and odorless. Other causes of oxygen deficiency are use of compressed gasses, combustion, welding, use of fire suppressants. All of these in a confined space or area of low ventilation are significant concerns.

EFFECTS OF OXYGEN DEFICIENCY

The following table summarizes the health effects of oxygen deficiency.

Volume % O	**Effect on Healthy Person**	**Approximate Time**
17	Deep Breathing Faster Heartbeat	Rapidly
16	Dizziness, Slower Reaction Time	Rapidly
15	Impaired Attention, Judgment and Coordination, Intermittent Breathing, Rapid Fatigue, Loss of Muscle Control	Rapidly
12	Very Faulty Judgment Inability to Move, Loss of Consciousness, Brain Damage	10 min. 10 min. 2 hours
10	Inability to Move, Nausea, Vomiting Loss of Consciousness	4 min. 10 min.
6	Loss of Consciousness Coma Death	30 sec. 1 min. 5 min.

Effects can become permanent if exposure is not terminated quickly. The major effects hindering escape are disorientation and unconsciousness.

CLASSIFICATION LEVELS OF ODH

There are five ODH classes: 0 through 4, with 0 being the least hazardous. Each class requires controls and posting commensurate with the hazard. Classification is based on the likelihood of fatality and the probability of occurrence. There are no areas at BNL with a classification greater than Class 1. RHIC Building 1005R (the refrigerator building) is a Class 1 area. Additional control measures and training are required for entry into a Class 1 ODH area.

This training allows you to enter Class 0 ODH areas at RHIC. The following are examples of Class 0 areas at RHIC:

- Collider Tunnel (not Intersection Regions at STAR and PHENIX)
- Service and Support Buildings 1002B, 1004B, 1006B, 1008B, 1010A, 1012A (buildings with valve boxes)
- Building 1005E (west end, Helium Reliquifier section)
- Compressor Building 1005H

WHEN IS EVACUATION OF AN ODH AREA REQUIRED?

Any one or combination of the following requires an immediate evacuation of an ODH area:

- The in-place oxygen monitors activate an alarm. At the RHIC complex, Blue strobes accompany an audible alarms.

- A vapor cloud is observed inside the ODH area or a loud "whooshing" sound is heard (even if no alarm is seen or heard).

The evacuation procedure is as follows:

- Leave the area, moving away from any vapor cloud or other potential problem.
- Stay Low! Do not use vertical escape exits, use only horizontal exits.
- If someone is in danger, hurt or feeling ill, call 2222 or 911. Otherwise, call the Control Room.

It is important to remember that you should not re-enter, even with an escape pack. Let the Fire/Rescue Group handle it. ODH deaths usually come in pairs; more than 50% of ODH deaths are of people re-entering an area trying to save another person. One or two breaths could cause loss of consciousness under certain conditions, and lung damage is possible if the gas cloud temperature is -50 to -70 ºC.

LABORATORY COMPUTERS

Any User who has access to the BNL Network and its computing resources must complete a BNL Course titled "Cyber Security". Essentially all Users will be required to complete this training.

SAFETY ATTITUDE

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 individual failures added up to a tragedy. A film describing this incident 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 harms way. Instead, Plan Your Work and then Work Your Plan.

Alcohol/substance Abuse:

Employees or Guests of the Laboratory who abuse alcohol and/or controlled substances pose unacceptable risks to the safe and efficient operation of the Laboratory. In addition to jeopardizing employee safety and/or impacting on performance, conduct and reliability, substance abuse is illegal.

LIAISON PHYSICISTS

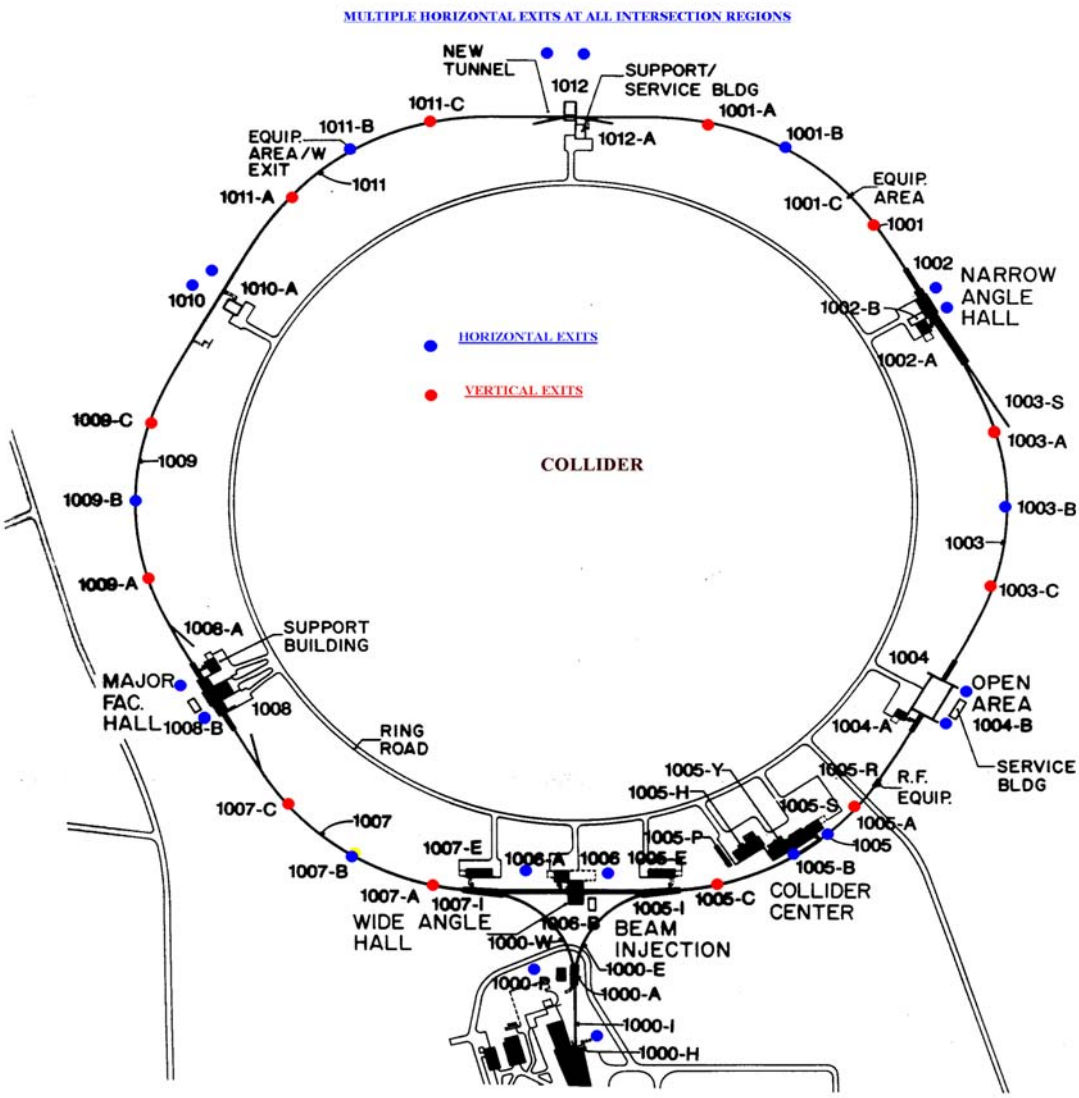
Your Liaison Physicist is your primary contact for information concerning Environmental, Safety and Health issues concerning the experiment. An up-to-date list of Liaison Physicists is maintained at the web site: http://server.ags.bnl.gov/bnlags/liaisons.html. The following are Liaison Physicists as of the time of this writing:

Experiment	Liaison Physicist	Telephone
STAR	Wuzheng Meng	2120
PHENIX	Yousef Makdisi	4932
PHOBOS	Don Barton	7925
BRAHMS	Dana Beavis	7124
PP2PP	I-Hung Chiang	7903

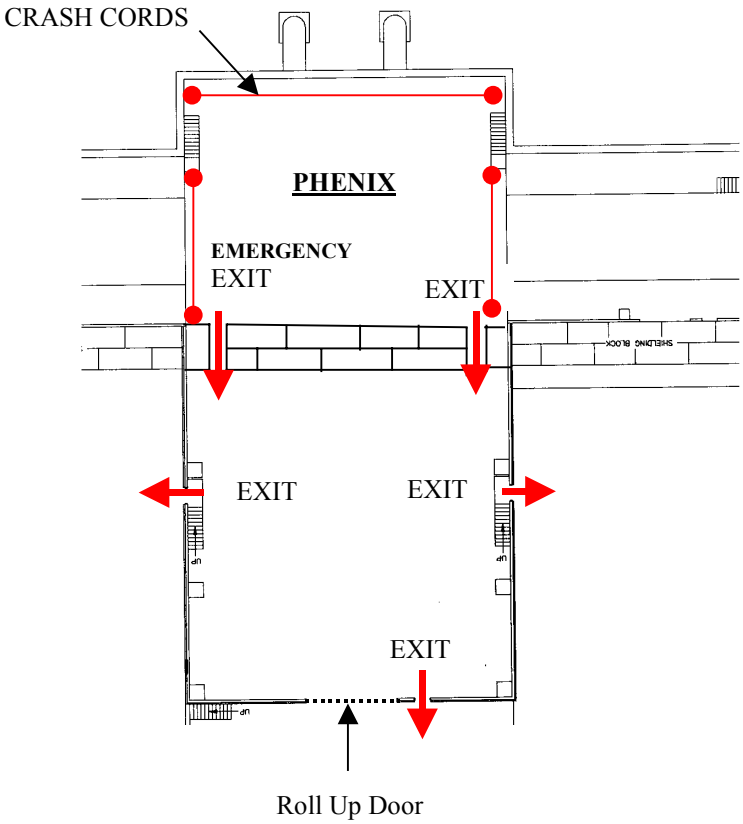
EMERGENCY EGRESS DIAGRAMS

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

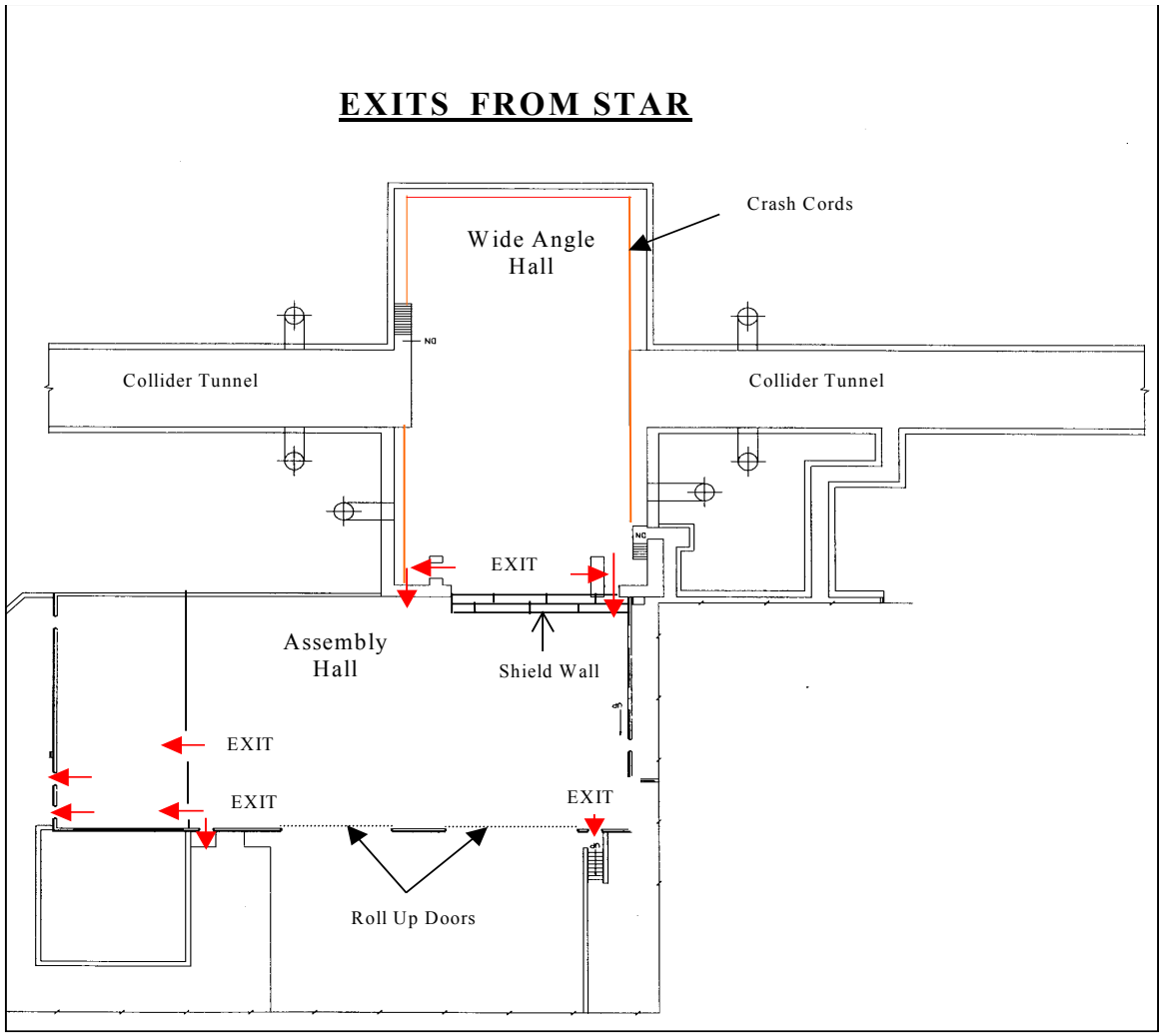
EXITS FROM COLLIDER TUNNEL



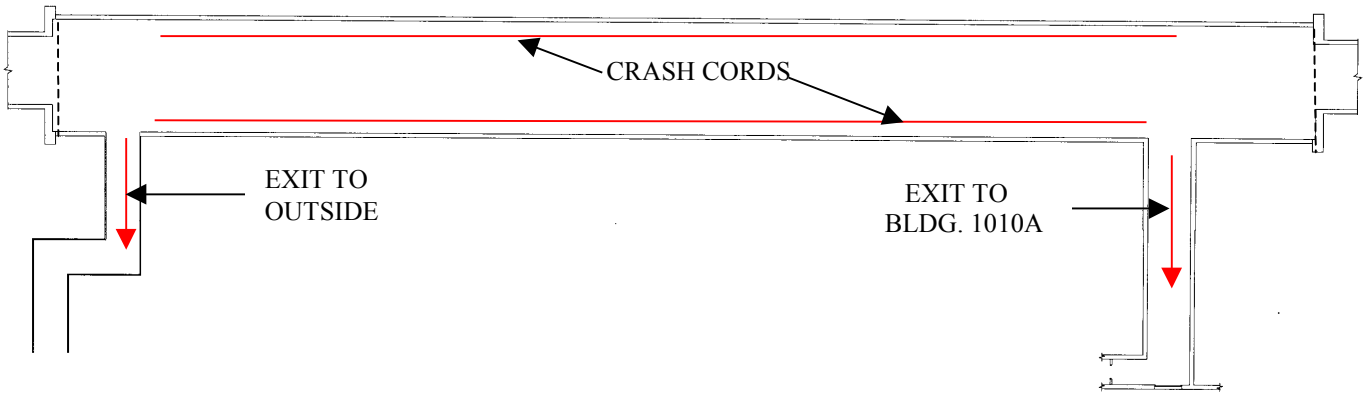
EXITS FROM PHENIX



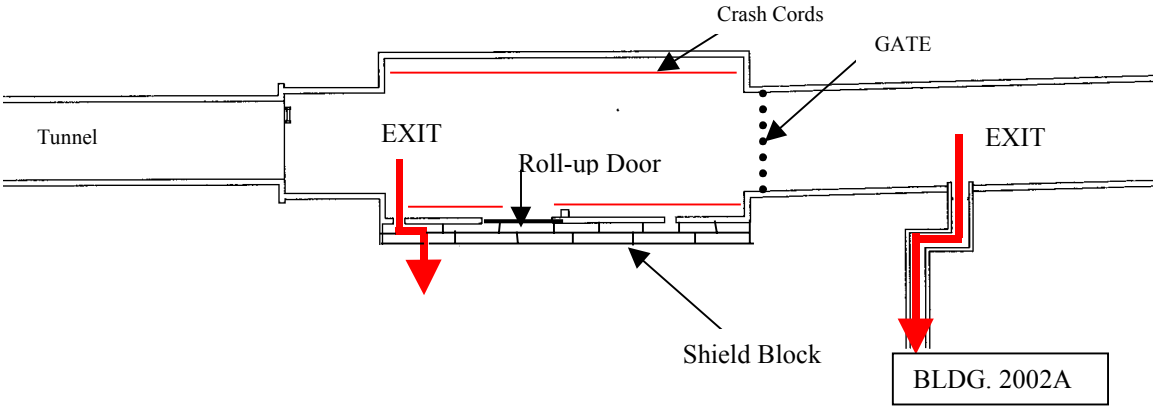
EXITS FROM STAR



EXITS FROM PHOBOS



EXITS FROM BRAHMS



LIST OF ACRONYMS

AGS - Alternating Gradient Synchrotron
ALARA - As Low As Reasonably Achievable
BNL - Brookhaven National Laboratory
BSA - Brookhaven Science Associates
C-AD - Collider Accelerator Department
DEC - Department Emergency Coordinator
DOE - United States Department of Energy
ESH - Environment, Safety & Health (e.g.: ESH Coordinator)
FEB - Fast Extracted Beam
HP - Health Physics
IR - Intersecting Region
LEC - Local Emergency Coordinator
LOTO - Lock Out / Tag Out
LE - Liaison Engineer
LP - Liaison Physicist
MCR - Main Control Room
OC - Operations Coordinator
ODH - Oxygen Deficiency Hazard
OSHA - United States Occupational Safety and Health Administration
PAAA - Price Anderson Act Amendment
PPE - Personal Protective Equipment
RCT - Radiological Control Technician
RWP - Radiation Work Permit
SEB - Slow Extracted Beam
SOP - Standard Operating Procedure
SRD - Self-Reading Dosimeter
TLD - Thermo-Luminescent Dosimeter