C-A RADIOBIOLOGY USERS TRAINING

For Year 2002-2003
Safety Associated With The
Primary Experimental
Areas at AGS & BAF

STUDY GUIDE

September 2002, Rev 00

This training incorporates the following BNL
training courses:
Equivalency for:
Stop Work (GE-Stopwork)
Emergency Planning (GE EMERGPLAN)
GET (HP-V001)

INDEX

C-A RADIOBIOLOGY USERS TRAINING

LEARNING OBJECTIVES OR
WHY TAKE THIS COURSE?

This Course is required if you want unescorted access into primary and target areas associated with Radiobiology experiments at the AGS or BAF facilities. Primary areas include target stations and areas where the beam is fully enclosed in a tube like enclosures. Primary areas are fully enclosed by shielding or fences and have a barrier on the roof. These areas have interlocked access gates. Thus require you to have facility specific knowledge.

This course covers:

1. the physical design features and administrative controls that are used to prevent accidental exposures in experimental areas, and
2. conventional safety issues.

You will learn about the posting and access controls for C-A Radiological Areas. The requirements for entering and working in these areas will be covered. The response to emergencies and the guidelines for control of emergency exposure will also be presented. A pre-requisite for this course is BNL Radiation Worker 1 training. Annual retraining in C-A Radiobiology Users Training is required.

Please be aware that successful completion of this course does not allow you to work in any Contamination Areas. Further training in BNL "Contamination Worker" is required.

You cannot remove activated materials from C-A primary areas and place them in uncontrolled areas without the assistance of Radiological Control Technicians (RCT).

Your Experiment Spokesperson or Liaison Physicist is responsible for ensuring the collaboration is qualified in experiment specific training.

Question: if an area is improperly entered; for example, by climbing over a shield block or by slipping through a hole in a gate, could you be killed by direct exposure to the beam?

Answer: yes. The beam can be intense enough to deliver a lethal dose.

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

1. heavy objects,
2. mechanical equipment,
3. overhead cranes,
4. heights,
5. high magnetic fields,
6. hot and cold surfaces,
7. steam,
8. high-voltage and high-current electrical systems,
9. noise hazards,
10. radio frequency radiation, and
11. contamination.

We strive to maintain an excellent safety record in such a complex environment

without undue inconvenience to the Users. With your help, over the last few years we have significantly 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 primary and secondary experimental areas. Each of you must familiarize yourselves with all applicable safety regulations and experiment procedures.

RESEARCH SUPPORT SERVICES

A Liaison Engineer is assigned to coordinate and assist in the setting up and running of the experiment. Your Liaison Engineer is the primary contact for the experimental team during the construction phase. The engineer will prepare a detailed design layout of the experiment, including a time estimate for completion. The Liaison Engineer will arrange for rigging, survey, safety reviews, and such requirements as electrical work, plumbing, carpentry and air conditioning. Items that require a safety review or other advance approvals are listed in C-A Operations Procedure Manual (OPM), Chapter 9. After the experiment is running, all operating problems are handled by the Facilities and Experimental Support Section (F&ES) and Collider Accelerator Support Watch (CAS). The Liaison Engineer must be consulted regarding special requirements or modification of the experimental set-up.

A Liaison Physicist is assigned to your experiment. The Liaison Physicist is a consultant to the Liaison Engineer. The Liaison Physicist is your primary contact for safety-related information associated with 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 also optimizes the beam during sharing conditions. He should be consulted to help solve ionizing radiation problems, and to solve other problems of this general safety character.

An Experimental Spokesperson is a 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 the C-A 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 are inventoried and leak checked as required by Federal Law. The Experiment Spokesperson is the person responsible for all radioactive sources brought into the C-A, no matter the size of the source or the origin of the source. That is, even if the source comes from another BNL Department, THEN it must be inventoried at C-A. These sources are typically used to calibrate or check the response of experimental detectors. The Experimental Spokesperson shall ensure the source is checked by HP (x4660) for leakage every six months, and he/she shall enforce the C-A Sealed-Source Inventory Procedure. Source inventory forms are available from the C-A Source Custodian.

- It is an Experiment Spokesperson's responsibility to ensure that all work by the collaboration is properly planned and reviewed for ES&H issues.

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

Question: who is the primary contact for safety information regarding a modification to your experiment?

Answer: the Liaison Physicist.

C-A CONTACTS LISTS

The following list of contacts provides you with a brief reference, which you should place near your telephone in the experimental area.

C-A CONTACTS	EXT.
Liaison Physicist (Adam Rusek)	5830
Liaison Engineer (Dave Phillips)	4671
Experimental Spokesman (Marcelo Vazquez)	3443
Building Manager 912	2046
Building Manager 958	2046
C-A Associate Chair for Safety	4250
C-A Department Chair	4611
C-A ES&H Coordinator	7200
C-A ESHQ Division Head	5272
Environmental Coordinator	7520
Maintenance Coordinator	7205
CAS Watch	2024
Health Physics Office at C-A	4660
Main Control Room	4662
Operations Coordinator	4662
Safety Inspection	7934
Security Access Controls Group	2053
C-A Source Custodian	5636
Training Manager	7343
Training Office	7007

C-A ESHQ Division Web:
http://www.rhichome.bnl.gov/AGS/Accel/SND/

BNL USER CENTER

The RHIC & AGS Users' Center is located in building 355A, telephone 631-344-5975, or e-mail userscenter@bnl.gov. All users are required to check in and out at the Users' Center.

During the check in process you will be familiarized with Brookhaven's commitments and obligations to its visiting population as well as BNL's expectations and requirements for individuals visiting the laboratory.

The checking out process at Brookhaven is very important. When you leave the laboratory, this formal procedure addresses such issues as radiation badges, access cards, library books, experimental equipment and supplies, decommissioning of experiments, and shipping equipment and materials back to your home institution.

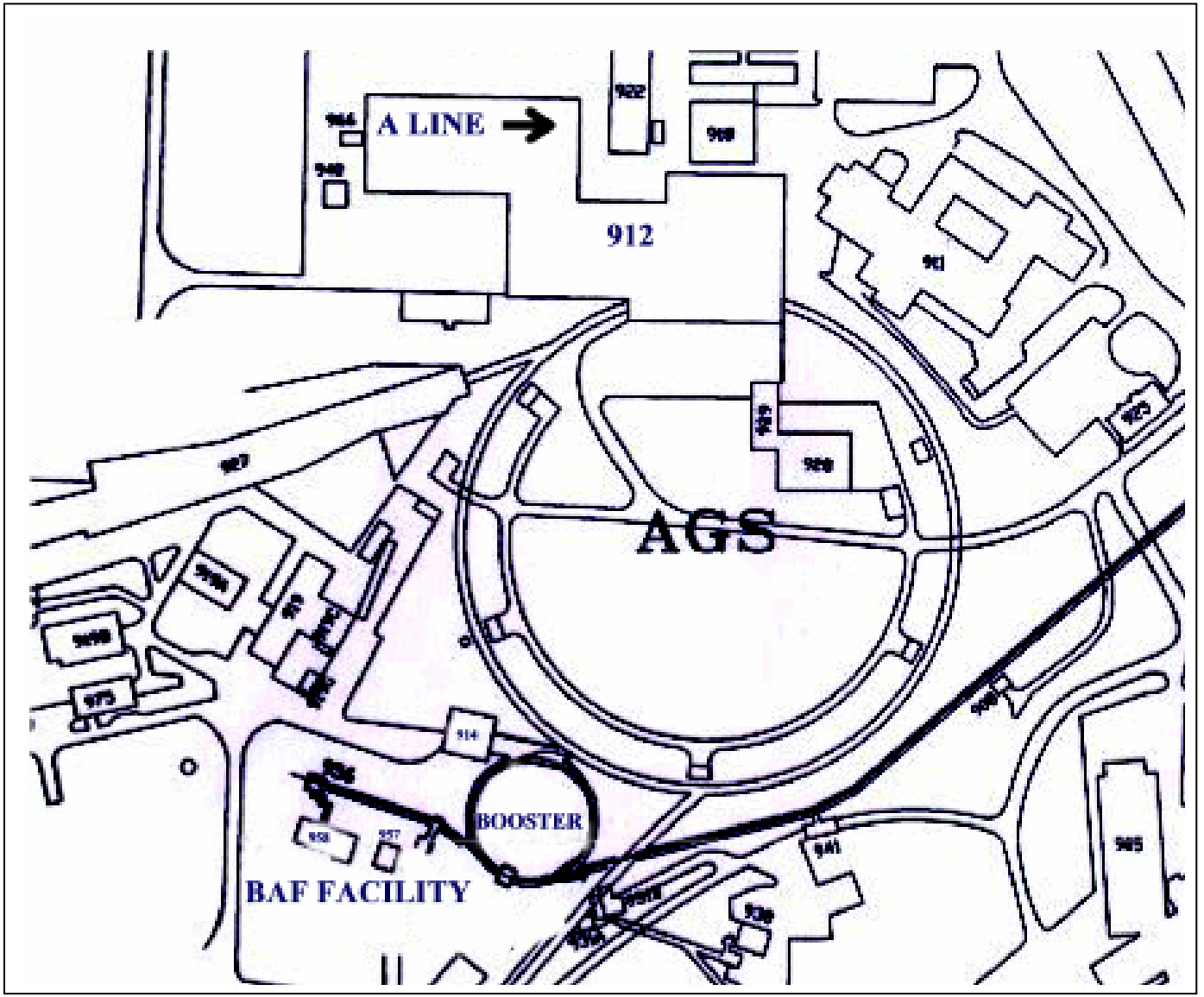
EXPERIMENTAL FACILITIES DESCRIPTION

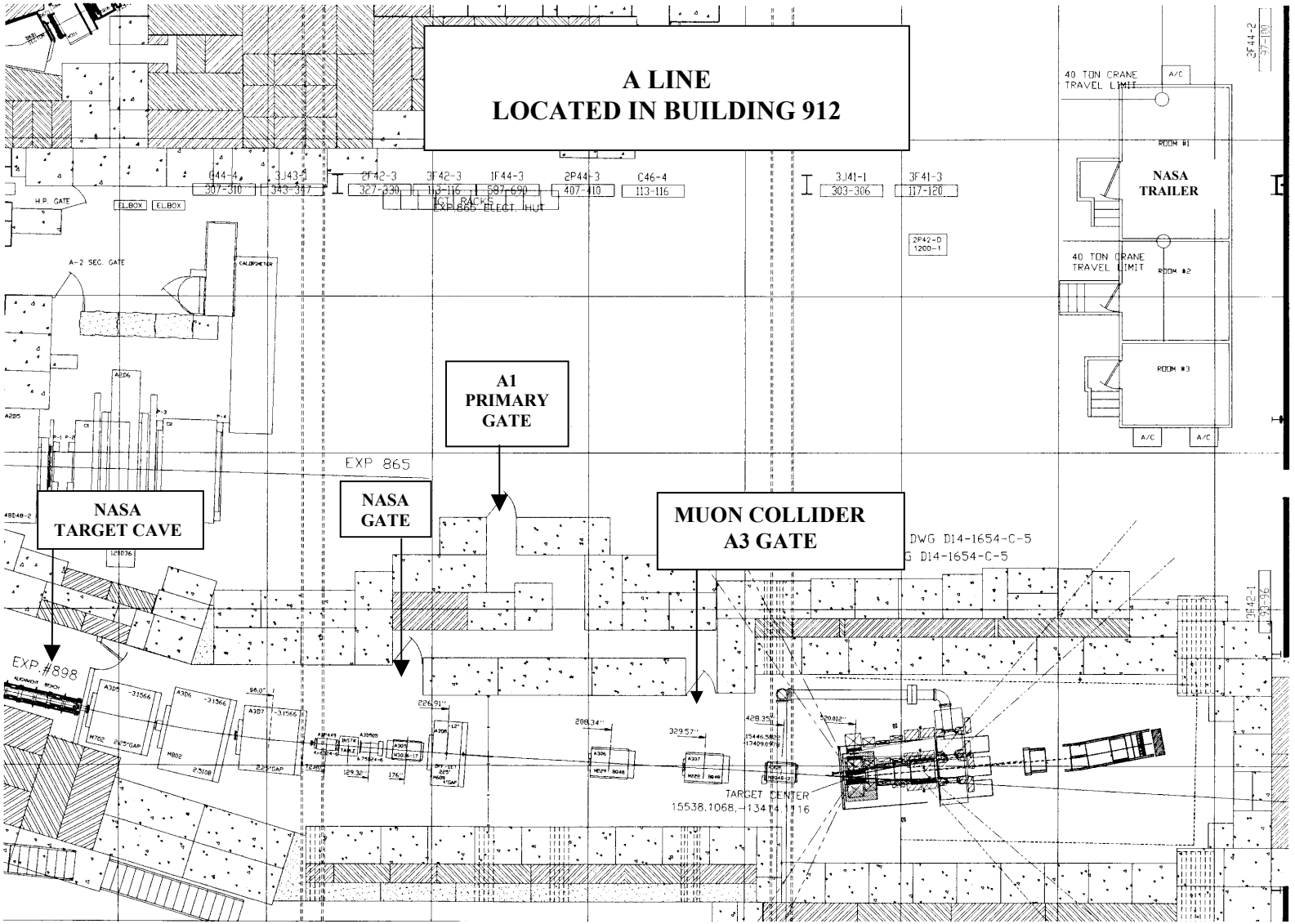
1. the A-3 Line/Target cave at AGS
2. Booster Applications Facility (BAF) located in building 958

Primary areas are fully enclosed by shielding or fences and have a barrier on the roof. They generally incorporate interlocked access gates.

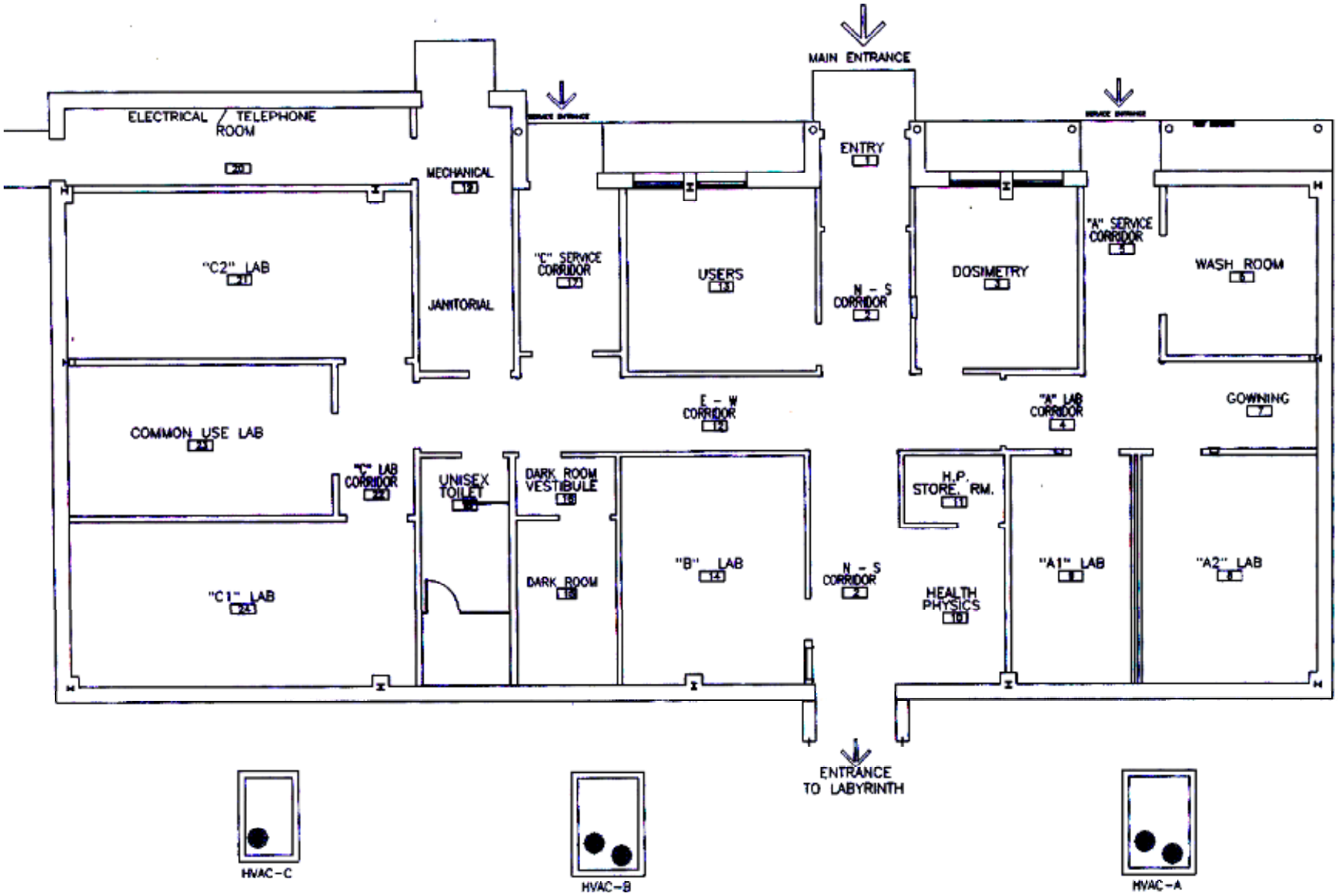
Views of the experimental areas are given on the following pages. The overall radiological areas that surround the AGS complex are also pictured.

RADIOBIOLOGY EXPERIMENT AREAS AT C-A
A-LINE and BOOSTER APPLICATIONS FACILITY




A LINE
LOCATED IN BUILDING 912
A1
PRIMARY
GATE
NASA
TARGET CAVE
NASA
GATE
MUON COLLIDER
A3 GATE
NASA
TRAILER
40 TON CRANE
TRAVEL LIMIT
EXP 865
EXP #898
TARGET CENTER
15538.1068,-13414.1116

BOOSTER APPLICATIONS FACILITY (BAF) FLOOR PLAN



HANDLING LEAD (Pb)

You will encounter Pb in the primary areas. Please be aware that handling Pb may be hazardous and you are required to use personnel protective equipment. Pb may be found in brick, sheet, or cast forms, or as wool which is used in Pb blankets. In most applications, the bare metal should be covered or painted if practicable. You need to wear safety shoes in addition to gloves when handling Pb bricks or sheets of Pb. You are not allowed to shape, drill, or otherwise work with Pb in any way that causes it to become dispersible. If you need assistance with shaping or cutting Pb, then contact the C-A ESH&Q Division Head (x5272, pager 4820), or ES&H Coordinator (x7200, **text pager** 9-453-5940). **Note: From onsite, a text pager requires you to dial 9-453-5940. Enter your phone number or extension and then hang up.**

ELECTRICAL SAFETY TRAINING

If you work on electrical circuits that are powered through circuit breakers, disconnect switches and / or fuses, then you must Lockout / Tagout (LOTO) the circuits. OSHA, BNL and C-A require that all workers performing these tasks have appropriate training.

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

- Electrical Safety,
- Lockout / Tagout and
- Working Hot.

Electrical safety training is required if you plan to work with:

- AC voltages greater than 50 Vac,
- DC voltages greater than or equal to 50 Vdc,
- systems with greater than 10 ma of available current, or
- systems that are capable of releasing 10 joules or more of energy instantaneously.

Contact with energized electrical circuits may not kill but can knock you off a ladder or cause you injury. Additionally, the short circuit capacity of the 120/208 and 480 volt systems is much above that encountered in most industrial and/or research facilities. All connection and disconnection to these systems must be made by BNL personnel only. You must use caution on any equipment connected to these systems since a short circuit can produce a large arc with a resultant molten metal spray.
You should be aware of the requirements for fusing and other protective circuitry for your equipment.

Contact the C-A Training Manager (x7343) to arrange for additional electrical safety training. **You are forbidden to work on energized electrical systems (working 'hot') unless you receive authorization from the C-A ESH&Q Division Head (x5272, pager 4820), ES&H Coordinator (x7200, text pager 9-453-5940).**
Label your equipment. Be familiar with your equipment and do not use anything that seems unsafe. **IF you do not know from whence it came, THEN DO NOT use it.**

Recently, Users found a home made extension cord near their experiment, and decided to use it. This unknown cord had the hot and neutral reversed and the ground had been cut or corroded away. Aside from damaging a computer and a measuring

device that cost several thousand dollars, this hazardous cord was potentially lethal since the safety ground was not intact. The bottom line is DO NOT use homemade extension cords; USE the molded type.

You should know the location of the emergency-off controls for power to your equipment. There should be no exposed electrical terminals in your equipment that present a hazard to yourself or other Users.

All cables should be labeled and properly terminated or removed when disconnected. This will prevent potential shock hazard to anyone working near unused cables.

Question: while working on your equipment, you encounter exposed conductors and you are not certain if they are live, what would you do?

Answer: warn your collaborators and contact your Liaison Physicist.

FLAMMABLE GAS/LIQUID SAFETY

Many experiments involve the use of flammable gases, and flammable liquids. The gas distribution and gas mixing systems must meet the requirements of BNL Environmental, Safety and Health (ES&H) Standards. These standards are issued to Liaison Physicists, Liaison Engineers and Experiment Spokespersons.

COMBUSTIBLE MATERIALS

Users occasionally collect wood, plastic, paper or other combustible matter in significant quantities near experiments. We must strive to remove these materials where possible, and we should strive to meet the life-safety code by not blocking exits or aisle ways with these materials. Storage areas are assigned to experiments for the purpose of storing experimental equipment, cables, packing materials and other combustible items. Consult your Liaison Physicist.

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 Pull Box and telephone 2222 or 911, (cell phone 631-344-2222 or 631-344-911) Fire Rescue Group. Once a fire has been reported 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.

MAGNETIC SAFETY

Use extreme caution with iron and steel objects when working around magnets, especially those with large gaps. Follow all magnetic safety plans that are specific to your experiment. Be sure you do not inadvertently energize a magnet before the area is clear. Remember the field may be effective at a surprisingly large distance. Aside from possibly pulling ferrous objects from your grasp, your credit cards may be damaged if you get too close.

The American Conference on Governmental Industrial Hygienists (ACGIH) recommend exposure limits for static magnetic fields. Exposure of the whole body should not be allowed in fields greater than 600 gauss on a daily basis (8-hour time-weighted average), and extremities like your arms and legs should be exposed to less than 6000 gauss (8-hour time-weighted average). Cardiac pacemaker wearers should not be exposed to fields greater than 5 gauss. DOE has adopted ACGIH recommendations as its own standards and has indicated this through DOE Orders. Thus, you should limit your own personal exposure according to these rules.

CHEMICAL SAFETY

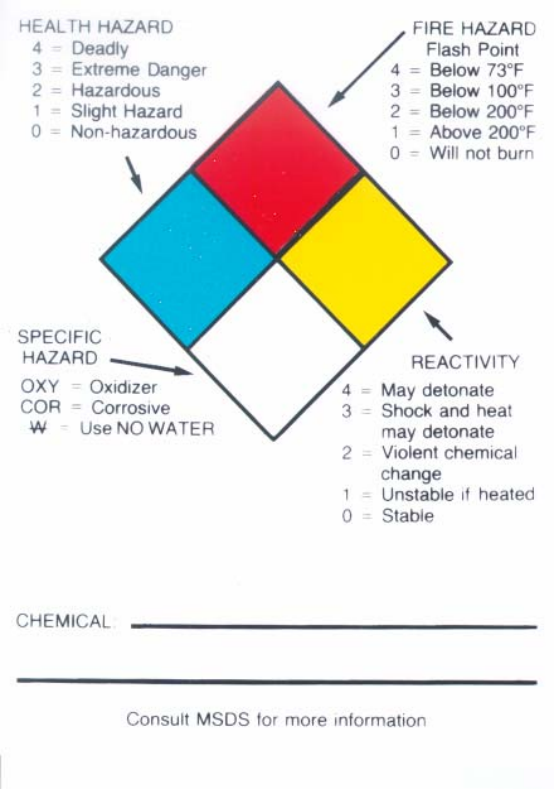
For your safety, purchased chemicals are inventoried by the Laboratory prior to delivery for end use. All chemicals, including anesthetics, to be used in your experiments must be clearly indicated in your experimental proposals . If you bring un-inventoried or unapproved chemicals on site contact the ES&H Coordinator (x 7200, text pager 9-453-5940). 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 the Experimental Spokesman Marcelo Vazquez x 3443 to ascertain the required documents and procedures prior to using and bringing any controlled substance on to the laboratory site.

INFORMATION ON HAZARDS, YOUR RIGHT TO KNOW .

You have the right to know about potential health and safety hazards in your workplace, 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 (x7200, text pager 9-453-5940). The Coordinator can provide you with information on the Laboratory's policy on hazardous information, how to obtain Material Safety Data Sheets (MSDS) and interpret them. 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 various materials containing structures and containers to the degree of hazard for these materials.

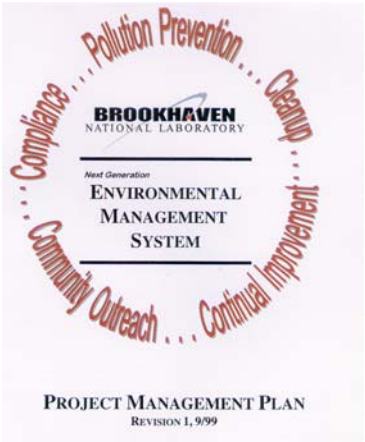


The ES&H Coordinator can also provide information on how to select and use protective equipment, and explain the labeling system used on chemical containers.

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, this is not always practical. In some cases protective clothing and 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-A ES&H Coordinator (x7200, text pager 9-453-5940).

ENVIRONMENTAL MANAGEMENT SYSTEM



The goals of the Environmental Management System are to ensure that you know and comply with environmental regulations associated with your work, that

you know the potential environmental aspects and impacts associated with your work and how to prevent, respond and mitigate impacts and that you strive to practice the techniques of pollution prevention and waste minimization. BNL employs the EMS program defined by the International Standard, ISO 14001. There are five points to BNL's policy and commitment.

1) Pollution Prevention
Strive to prevent pollution, minimize wastes and conserve resources.
2) Compliance
Comply with all applicable environmental requirements.
3) Clean Up
Aggressively correct and clean up existing environmental problems.
4) Continual Improvement
Protect our ecosystem and community by continually improving the way we manage our programs.
5) Community Outreach
Openly communicate our progress and performance to our community and stakeholders.

The work that you perform may have potential environmental impacts associated with it. If so, you will be required to observe specific controls designed to prevent such impacts. Your Liaison Physicist can explain those controls, or you may contact the C-A Environmental Compliance Representative (x2905) for details.

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) well in advance to establishing any airborne, liquid or solid radioactive- or hazardous-waste-stream. The C-A Environmental Coordinator is 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-A is ultimately disposed of must also be followed.

- Do not place clean materials in radioactive waste bins.
- Substitute reusable materials where possible.
- Use minimum quantities of materials.
- Segregate wastes.
- Do not leave unnecessary items in primary areas.
- DO NOT LEAVE WASTE BIOLOGICAL ITEMS USED IN EXPERIMENTS AT C-A. ALL WASTE IS TO BE RETURNED TO MEDICAL OR BIOLOGY DEPARTMENT.

Each person is responsible to ensure that they handle, accumulate or dispose of waste by using adequate controls and documentation. Your Liaison Physicist can

explain those controls, or you may contact the C-A Environmental Compliance Representative (x7045) or Environmental Coordinator (x7520) for details.

SPILLS

The C-A Department is required to report spills. The C-A Department must always report quickly to outside agencies on events that deal with impacting the environment. Even minor events such as spilling any amount of oil in an outdoor area may require reporting. The rules are such that we must consider reporting spills of any type or size. IF you spill any hazardous liquid or oil outdoors on the bare soil or if you spill 5 gallons or more of hazardous liquid or oil on any impervious surface, THEN call x2222 or 911, contact the C-A Main Control Room (x4662), the C-A ES&H Coordinator (x7200) or the C-A Environmental Coordinator (x7520) as soon as you can. DO NOT leave a message on an answering machine. Report the spill giving your name plus information on the location of the spill and the type of material involved if you know it.

Spills that do not have to be reported are spills that occur as a result of routine operations as long as the following conditions are met:

- The spill occurs indoors.
- The spill occurs on an impermeable surface.
- The material spilled is not a highly toxic or highly volatile material (such as methylene chloride).
- The material spilled does not contain (or suspected to contain) polychlorinated biphenyls (PCBs).
- The person reporting the spill has appropriate training and materials to clean up the spill.
- The spill is cleaned up immediately.

The ES&H coordinator is to be contacted in the event of a spill to evaluate and coordinate the clean up efforts.

BNL MANAGEMENT SYSTEMS

Brookhaven National Laboratory has put into practice a series of management systems to help ensure that work is done in a safe and environmentally conscientious manner. These management systems detail the processes and procedures that are associated with different types of work and are available to everyone via the BNL Standard Based Management Systems (SBMS) internet web site. SBMS is BNL's method for implementing the Integrated Safety Management System (ISM). ISM combines Environmental, Safety and Health requirements into the process for planning and conducting work here at the laboratory. The Work Planning Process governs physical work activities.

WORK PLANNING AND SCREENING AT C-A

All jobs at C-A must be screened for Environmental, Safety and Health (ESH) hazards. The hazard levels for screening work are 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 any 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-sight environment.

Many Tasks necessary to maintain, repair, and debug experiments will be carried out by Users. Much of this work is deemed low hazard or "Skill of the Craft". A list of "Skill of the Craft Jobs" or "Work Plan" is maintained at each experiment. Users are required to review this document.
Jobs involving Users are normally screened during formal reviews and walk-throughs by the C-A Experimental Safety Review Committee. However, last-minute changes to experiments that require Users to perform jobs that fall in the moderate to high hazard category must be brought to the attention of the Liaison Physicist. **It is an Experiment Spokesperson's responsibility to ensure that all work by the collaboration is properly planned and reviewed for ES&H issues.**

CONDUCT OF OPERATIONS

OPERATIONS COORDINATOR **X4662**

The main control room (MCR) is the focal point of beam control and status. While the accelerator is operational, the MCR is staffed. Call x4662 for immediate assistance on any problem.

The Operations Coordinator (OC) is authorized to enlist the support necessary to maintain or restore the accelerator or experimental support system to operational status. The OC is responsible for providing beam that is satisfactory to the experimenter. The OC keeps current on the status of all experimental groups in the experimental areas, and in case of operational conflict or incompatibility, attempts to find a resolution. For assistance in carrying out his/her duties, the OC consults with the scheduling physicist, technical specialists, and departmental managers.

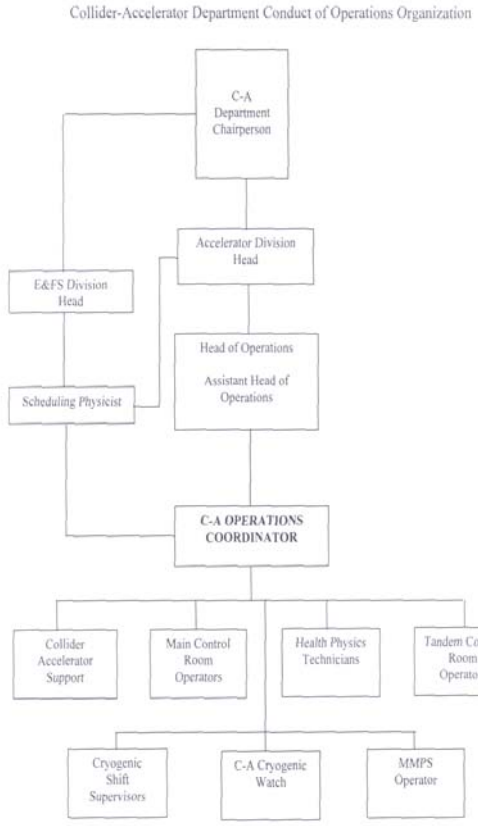
The C-A Department urges you to communicate with the OC via the MCR whenever you need assistance on any matter. This is particularly important on the shifts that occur during non-standard work hours. The OC may not be able to answer questions directly or provide the assistance

directly, but he will make use of the operational groups who report to the MCR.

After the experiment is running, all operating problems are directly handled by the CAS Watch.

You may contact the CAS Watch by calling x2024 or by calling the OC x4662. Problems involving collimators, power supplies for beam-line magnets, Hall probes, beam separators, cryogenic targets, vacuum systems, vacuum window shutters, air conditioning, electrical equipment, and requests for emergency rigging should be reported to the CAS Watch.

You only need to remember one telephone number, x4662, in order to get assistance on any matter. That is, IF you have any problems or questions, THEN contact the MCR (x4662). The OC will assist you or direct you to the appropriate safety or operations professional.



REMEMBER:

During C-A operations, contact the Operations Coordinator (x4662) regarding any problem; the OC can make all the necessary notifications or arrange for assistance.

PRICE ANDERSON ACT AMENDMENTS (PAAA)

It is important to make you aware of the absolute requirement to follow all radiation safety rules at C-A facilities. Federal law (PAAA) provides for enforcement penalties if you do not follow the rules fully. Personnel have been the subject of criminal investigations when found to willfully remove a radiation barrier. Thus, we request that you pay particular attention to the radiation safety rules that follow.

Are Users at C-A accepting additional legal liabilities when signing documents related to compliance with radiation safety rules under the Price-Anderson Act Amendments? The short answer is that the worker incurs no personal liability under the provisions of the Act unless he/she intentionally acts to violate the radiation safety rules.

The Price-Anderson Act sets up a regulatory scheme for enforcement of radiation safety rules, including radiation protection standards (10 CFR 835). Failure to comply with those rules, or to identify and report non-compliance to DOE, subjects the Laboratory, and the employee, to an enforcement action. A goal of PAAA is to protect employees and the general public from radiological hazards.

When signing documents related to radiation safety, a worker is essentially confirming that he/she will do his/her assigned work according to the rules. The signature does not mean that the worker is guaranteeing that the work will be carried out perfectly or that there is no potential for a violation. It does mean that the worker is performing his/her duties to the best of their ability and has made a good faith effort to comply with the radiation safety rules. A "good faith effort to comply with the rules" means that the worker has familiarized him/her-self with the requirements of regulations that fall within his/her area of responsibility. Having done so, he/she should be in a position to approve or sign-off on procedures or training to carry out work involving radiation safety.

WARNING

It should be understood that any worker who intentionally violates any regulation, regardless of whether the worker signs any document related to compliance, might be subject to criminal prosecution or other disciplinary action.

RADIATION HAZARDS

- PRIMARY BEAM: in-beam dose rates up to 10^{14} mrem/h from hadrons.
- SECONDARY BEAM: in-beam dose rates up to 10^{11} mrem/h from hadrons, and leptons.
- FAULTS: radiation penetrating through shielding from unplanned beam losses may lead to doses of several tens of mrem from neutron and gamma radiation near shielding or fences. Faults may last up to a period of about nine seconds before machines are interlocked off.

- NORMAL OPERATIONS:
  - About 1 to 2 mrem/h or less in continuously occupied areas from neutron, and gamma radiation that penetrates the shielding.
- RESIDUAL RADIATION:
  - Primary beam components are up to 10,000 mrem/h (gamma).

The principal radiation hazard associated with the C-A primary areas derives from the high-level residual-radiation. Radiobiology experimental primary areas are selected areas where little activation has occurred.

Direct exposure to the beam is not possible if areas are entered in the correct way. However, exposure to radiation from unplanned beam losses in adjacent primary areas is possible. This may result from brief excursions lasting a few seconds such as during a beam crash due to loss of a steering magnet power supply.

RESIDUAL LEVELS IN PRIMARY EXPERIMENTAL AREAS WHEN BEAM IS OFF		
AREA	LOCATION	RESIDUAL LEVEL, mrem/h
A Primary Line	Radiobiology Station	0.5
BAF	Building 958 Target Area	0.5 (Anticipated)

The approximate dose rates shown in the previous table are based on radiation surveys taken shortly after operations and anticipated levels at BAF.

RADIOLOGICAL AREA DEFINITIONS

Controlled Area -- any area where access is controlled due to the presence of radiation above natural background levels or due to the presence of man-made radioactive materials. As a minimum, these areas are posted “Controlled Area.”

Radiation Area -- any accessible area where an individual may receive a whole-body dose greater than 5 mrem in one hour at 30 cm (1 ft). As a minimum, these areas are posted “Radiation Area, TLD Badge Required.”

High Radiation Area -- any accessible area where an individual may receive a whole-body dose greater than 100 mrem in one hour at 30 cm (1 ft). As a minimum, these areas are posted “Danger, High Radiation Area, TLD Badge and SRD Required.”

Very High Radiation Area -- any accessible area where an individual may receive a whole-body absorbed-dose greater than 500 rad in one hour at 1 m (3 ft). These areas are not posted at C-A since they are not accessible.

RADIATION LEVELS, AREA NAMES, AND TRAINING REQUIRED		
Allowable Radiation Level	Area Name	Training Course(s) Required
< 5 mrem in one hour < 100 mrem in one year	Controlled Area	General Employee Radiological Training (GERT) *C-A Facility Specific Training
> 5 mrem in one hour < 100 mrem in one hour	Radiation Area	Rad Worker I Training *C-A Facility Specific Training
> 100 mrem in one hour	High Radiation Area	*C-A Facility Specific Training

*Contact C-A Training Manager (x 7343) for specific training requirements

The C-A accelerator complex has many Radiation Areas, and dose rates may be greater than 5 mrem in an hour. These areas are marked-off by ropes, fences or building walls. All entrances, every forty feet of fence or rope, and many Hot Spots are posted with Radiation Area signs. In order to work in or pass through Radiation Areas without an escort, you must complete Radiation Worker 1 training.

In primary areas, the radiation level may be greater than 100 mrem per hour and up to 50,000 mrem per hour. In order to work in these areas, you must complete Radiation Worker 1 training plus facility specific training such as this course.

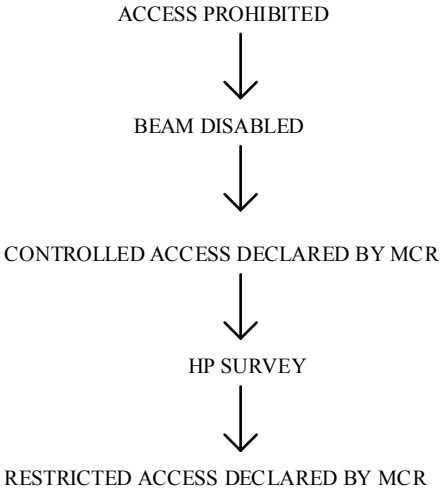
TRAINING SCHEDULE			
Course	Place	Usual Time	Challenge Exam Option
Rad Worker I Training (RW I)	Bldg. 703 Training Room Consult with Training Manager (x7343)	Every other Tuesday 9:00 a.m. to 4:30 p.m. Consult with Training Manager (x7343)	Contact Training Manager (x7343)
AGS Radiobiology Users Training For Access To Primary Areas	Contact Training Manager (x7343)	Scheduled as Needed	Contact Training Manager (x7343)

ACCESS CONTROL FOR PRIMARY AREAS

At the C-A, the Access Control system is the major design feature used for your protection and it has two states, Access Prohibited and Access Allowed. In the Access Prohibited state the machine is either operational or it is "cocked and ready to fire." Radiation hazards may be at their extremes in this state and are lethal. Thus, no entry is allowed.

To prevent entry, the electric key-strike on each access gate is disabled from the Main Control Room, and gates will no longer work with the Iris Reader. If a gate is forced open, then two sensors will detect the door's open position and cause at least two critical devices, such as beam stops, to intercept the beam before one can penetrate the area to any significant degree.

A flow diagram shows the steps C-A takes in going from the highest level of restriction to the lowest at Radiobiology Target Stations:



ACCESS PROHIBITED TO PRIMARY ARES

The following is true whenever the primary areas are in the Access Prohibited state:

- All electric strikes on access-gate doors are disabled; thus, preventing entry.
- All access gates have a minimum of two sensors to detect an open door.
- Two critical devices will stop the beam if interlock occurs.

In the Access Allowed mode, two major sub-states have been defined, Restricted Access and Controlled Access, and each has a number of significant features and requirements that are described in detail on the following pages.

ACCESS ALLOWED TO RADIOBIOLOGY PRIMARY AREAS

One of either of the following sub-states exist whenever the primary area is in the Access Allowed state:

- Posted as a RADIATION AREA
- Controlled Access
- Restricted Access

CONTROLLED ACCESS

Under Controlled Access, only a few electrical systems associated with the accelerators are locked out and tagged. Most electrical systems in experimental areas may simply be turned off. Access is controlled by the MCR.

- The conditions, requirements, hazards and restrictions that apply to Restricted Access apply to Controlled Access.
- While all systems have a barrier and most have been turned-off, only a few electrical systems have been locked out and tagged.
- A gate watch with C-A Operators will be established in the Main Control Room.
- User Authentication is through the Iris Reader.
- Access is accomplished by entering and exiting through one gate.
- Entry requires simultaneous door release at the gate and at the MCR.

Users must complete required training, Radiation Worker I, and C-A Radiobiology Users Training, prior to Iris Reader registration.

To enter the experimental Target Area the following procedure is to be followed:

1- Stand in front of the iris reader; look into the camera with either eye.

2- When confirmation is accepted the camera voice will state “Identification is completed”.

3- Remove key from the key tree (you will have approximately 2 seconds to remove key; keys must be removed in sequential order). YOU MAY NEVER LOAN THE KEY TO ANYONE ELSE.

4- To remove key turn it to the left and pull.

5- Contact MCR by speakerphone at access gate.

6- With key in hand proceed to the gate. Place key in the gate key switch. Turn key in conjunction with simultaneous release from the MCR (there will be a signal alarm buzzer).

7- Remove key and take it with you into the Target area.

8- When you are about to leave the target area, contact MCR using the speaker phone. Ask for the Operator to release the door, wait for alarm signal buzzer, and then open gate.

9- Return key to the key tree.

10- Stand in front of the iris reader; look into the camera with your eye to log out. The camera voice will state “thank you”.

RESTRICTED ACCESS

NOTE:

Entry is not controlled by the MCR during Restricted Access. All who are issued a Key or card may enter and exit at will.

Many electrical systems are locked and tagged during Restricted Access. This pertains only to beamline equipment not controlled by Users.

During Restricted Access to Radiobiology experimental target areas:

- There is no beam.
- Radiation Worker 1 Training and C-A Radiobiology User's Training are required for entry.
- A Key and TLD badge are required.
- C-A approved escorts may escort untrained Users.

GATES ARE LOCKED AND EXIST FOR RADIATION PROTECTION

- The iris reader and access key allow personnel to access target areas unescorted. NEVER let another person use your key or tailgate.
- You are the person most responsible for your safety. Use common sense. Never assume you know all the hazards.
- When in doubt, consult an expert. Your Liaison Physicist or the Health Physics Office (x4660) can assist you in all your radiation problems and concerns.

The SOLE reason the C-A Department has fences, gates and other barriers at the A3 beamline and BAF is to prevent radiation accidents. We know from national accident statistics that 10% of accidents result from unsafe conditions and that 90% result from unsafe acts. At C-A, 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-A 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-A.

Question: what is the main purpose of the locked gates around the AGS and BAF?

Answer: to protect persons from radiation hazards.

POWER FAILURE DURING ACCESS PROHIBITED MODE

If the battery back-up system for the access-control system fails during a power failure, then the access-controls system in the A Line immediately inserts beam stops and drops to the Restricted Access state. It will not remain in Access Prohibited or drop to Controlled Access since these states require power. If an area has dropped to Restricted Access following a power failure, **then DO NOT attempt to enter primary areas with a key immediately following a power failure; CONTACT the MCR first to verify that it is safe to enter the area.**

ARE ALL HIGH RADIATION AREAS POSTED?

Radiobiology target areas are less than 100 mrem/h during shutdown. These areas may be posted as a Radiation Area or as a Controlled Area during shutdown. The bottom line is to read the posting before you enter the experimental area in order to determine the appropriate radiological requirements.

The C-A accelerator complex contains a variety of radiological areas. The most common are Radiation Area and High Radiation Area. These areas are posted with a variety of signs that must be read before entering. These signs must be obeyed as they indicate training requirements and TLD requirements necessary to enter the area

properly. Exit requirements are also posted on these signs. Radiation field data is normally posted using survey maps at the entrances to the target areas.
These areas are also separated by a variety of barriers including fences, shield blocks and building walls. **DO NOT CLIMB OR DEFEAT THESE BARRIERS.** Always access these areas according to the rules.

Question: true or false - posting all hot spots at the AGS by health physics is reasonably achievable ?

Answer: true, but some spots are missed and signs may fall off.

GOLDEN RULES FOR RADIOLOGICAL AREAS AT C-A

- Do not climb over or defeat barriers
- Do not ignore signs, labels, alarms or warning tags
- If in doubt – Ask for help

Question: true or false? - the following may be ignored whenever you know the AGS is off: fences, barriers, signs, warning tags and alarms in radiological areas.

Answer: false. The AGS radiation protection program can only work if postings and barriers are obeyed at all times regardless of the status of the accelerators. Otherwise the event will be reportable.

C-A EXPOSURE PHILOSOPHY

Radiation Exposure at C-A Must:

- Have A Net Benefit
- Be As Low As Reasonably Achievable (ALARA)
- Be Within Limits

- Annually, about $100,000,000 will be expended to operate accelerators for experiments at the C-A complex. Once an experiment is configured, invaluable scientific information is obtained. Estimates of the economic worth of this information are difficult to enumerate, but it is assumed that this research has a net benefit.

Eating, drinking or smoking in a Controlled Area, Radiation Area or a High Radiation Area at C-A is not permitted. Doing so would increase the time spent in the area and correspondingly the dose, without increasing the net benefit. In addition, taking a shortcut through a Radiological Area in order to save time or to avoid inconvenience is not an appropriate practice.

ALARA STRATEGIES

Basic ALARA strategy on the part of the worker revolves around effective use of time, distance and shielding. Time tends to have a linear impact on dose reduction, distance a quadratic impact, and shielding an exponential impact. ALARA may also be incorporated into design and operations. The following are examples of ALARA at C-A that you may incorporate into your work:

- use temporary shielding
- Hold discussions in areas where the radiation level is the lowest
- Use remote handling equipment
- Plan work and practice
- Install quick disconnect and alignment features on beam-line components
- Install radiation resistant devices
- Assemble parts outside of the area
- Identify lower dose rate areas
- Use mirrors and video cameras

Question: true or false? - ALARA applies to anywhere it is reasonably achievable to reduce radiation dose.

Answer: true.

Question: how is ALARA achieved?

Answer: ALARA is applied most effectively at the design stage. It is accomplished through planning, job proficiency, shielding, and ALARA committee review and past experiences of staff and users.

ADMINISTRATIVE DOSE LIMITS

Administrative dose limits are an integral part of the dose reduction program employed by the C-A Department. These limits are LESS than the dose limits set by DOE and Federal Regulations.

C-A ADMINISTRATIVE LIMITS FOR VISITORS, UNTRAINED USERS AND MINORS
Untrained visitor or untrained User has a dose limit of 25 mrem per year. Minor (<18 years) dose limit is 25 mrem per year. Minors are not allowed to work in radiological areas but are allowed to visit or tour radiological areas.

C-A ADMINISTRATIVE LIMITS for RW-1		
Period of Interest	Maximum Individual Dose Limit, mrem	Individual Dose Limit With Line Authority Approvals, mrem
Calendar Year	1000	1000 to 1250 (C-A Chair Approval) 1250 to 2000 (Lab Director Approval)
Day	100	100 to 200 (Approval authority will be on the RWP)
Lifetime	N rem Where N Is Age of Person in Years	Laboratory Director Approval To Exceed N rem

The maximum daily dose to Radiation Worker 1 trained persons is 100 mrem. The C-A ESHQ Division Head may approve a dose between 100 and 200 mrem. The maximum calendar year dose is 1000 mrem. A formal approval must be obtained ***prior*** to going beyond 1000 mrem.

C-A Administrative Dose Limits apply to all personnel (staff, Users, visitors and contractors) who enter the C-A facility site. To exceed any C-A Administrative dose limit you must have written permission from the Department Chairperson or the Associate Chair for ESH&Q prior to exceeding any dose limit. If you are approaching any Administrative dose limit and foresee a need to exceed the limit, immediately notify your supervisor, and contact the FS representative.

After a female RWI-trained person voluntarily notifies the C-A management that she is pregnant, she is considered a declared-pregnant radiation-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. We limit the rate to no greater than 40 mrem per month. **Given that there is marginal sensitivity to detect low-level neutron dose, Experiment Spokespersons shall not employ declared-pregnant radiation-workers around beam lines during high-intensity proton operations.**

The no-dose option is mandatory for declared pregnant workers who have already exceeded 500 mrem during the gestation period.

After a person voluntarily notifies the C-A management that she is pregnant, she must follow-up and notify management when she is no longer pregnant.

Untrained Users or visitors are limited to no more than 25 mrem per year.

The annual dose limit to minors and students under age 18 years is 25 mrem. A visitor badge may be issued to a minor who plans to visit or tour a C-A radiological area. Minors are not allowed to ***work*** in radiological areas.

RADIATION WORK PERMIT (RWP)

All personnel entering any radiological area at the C-A complex must follow the requirements of the C-A Radiation Work Permits (RWPs) for these areas. Persons must read and sign that they are aware of the

RWP requirements. RWPs provides a mechanism to document the work review process involving radiation hazards.

Permits should be reviewed when you first enter the area. *Standing RWPs* are used to control routine and repetitive activities in areas that are radiologicaly stable. All entries into a Radiation Area require an RWP.

RWPs require signature on a RWP Sign-In Log. Signing the log allows individuals access to the specified areas throughout the duration of the permit.

TLD BADGE RULES

TLD badges detect exposures and verify the effectiveness of the C-A radiation protection program. Currently, TLD badges are read by the BNL Radiological Controls Division and results are back after a few weeks. If used, neutron-plastic packs attached to the TLD badges are read by Landauer Corporation and results are back after 8 weeks. TLD badges are changed the first Saturday of the month. Emergency TLD-badge read-out can be turned around immediately.

Every employee has a right to know their current accumulated dose. Monthly and cumulative dose for the year can be viewed on the C-A ESHQ web site. A copy of the dose record can be obtained through the C-A FS representative.

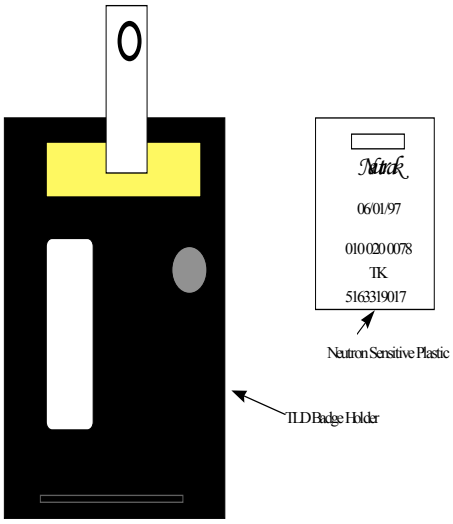
Occupational doses received from another facility should be reported to the FS representative to ensure your dose records reflect your current year's occupational exposure and reduce the possibility that you may receive exposure in excess of the annual limit.

Dose received from nuclear medical procedures are not included in occupational dose, but may affect the dose registered by your TLD. The FS representative must be notified prior to such a medical procedure so appropriate occupational dose monitoring protocol can be established.

TLD RULES

- You may not wear someone else's TLD badge
- Unless otherwise arranged, users are reissued TLD badges each month and must sign for each new badge at the C-A Training Office
- Return TLD badges to a TLD-Badge Board when not in use.
- Wear TLD badges in "RADIATION AREAS" or "Control Areas TLD Required"
- Check all radiological postings for TLD requirements.
- If you lose a TLD badge in a radiation area, even for a few hours, then notify the C-A HP Office immediately.
- Return TLD badges before TLD-badge change day, which is the first Saturday of the month.
- Return Red Visitor badges to the TLD-Badge Board next to the C-A Training Office in building 911 daily

TLD BADGE



Wear TLD badges on your torso and outside of your clothing.

TLD BADGES FOR VISITORS

- Visitors Are Those Persons Who Are Visiting – They Are Not Expected To Perform Work
- A Red-Stripe TLD Is Issued To Visitors For A Limited Period AND Cannot Be Re-Issued. This badge is normally issued for one day only.
- A *C-A Qualified* Escort Is Required At All Times For Red-Stripe TLD Visitors

A visitor's badge is obtained from the C-A Training Office or from the MCR during off-hours. In order to obtain non-escort status, attendance at Radiation Worker 1 Training and C-A facility specific Training is required.

A visitor TLD can be issued to untrained people with the approval of the C-A ESHQ Division Head, if the exposure is planned to be less than 25 mrem. A visitor with a red-stripe TLD is required to be escorted by a trained Rad Worker at all times.

Question: two students have just arrived from off site and you need them to help unpack equipment in Building 912 or BAF. What do you do?

Answer: contact the C-A ESHQ Division Head to help them obtain red-stripe visitor TLD from the C-A Training Office. You must escort them at all times they are inside a Radiation Area. It is best to get the person trained as soon as possible. Training materials are available in the C-A Training Office.

LOST AND UN-RETURNED BADGES

Please report a lost badge to the C-A Training Office or the HP Office. If a badge leaves the site inadvertently, please mail it back to the Radiological Controls Division, Building 120, Upton, NY 11973.

Recently a lost badge belonging to a User who worked inside a secondary beam line had results as high as 7,000 mrem. The badge was later determined to have fallen off the User's shirt and to reside for several hours on top of a spectrometer magnet while the beam was 'on' but without any person present.

After the running period was over and the User left for his university, the badge results were reported to C-A. The User later recalled that one-day during the run; he found his TLD badge on top of a spectrometer magnet when he moved across it in order to reach his detectors. He put the badge back on and performed his work; not aware the badge had likely fallen off during a recent prior entry. He indicated his badge was likely to have been missing for only a few hours during his three-month stay at AGS.

IF you think you may have lost your badge even for a brief period, THEN please notify the HP Group (x4660) as soon as possible. This information will help if we have to reconstruct events following an abnormal badge reading, although computer records of security system actions and area dose rates are also available to us.

In the past few years, the C-A HP office has conducted several hundred investigations for un-returned badges. The work-force cost of these investigations was estimated at $10,000. These investigation costs have been substantially lower than those of prior years, and we feel it was due to your cooperation. However, it could be reduced to zero cost. Please continue to leave badges at the assigned station or rack 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. Often they are not returned at the conclusion of an experimental run. Your continued cooperation in eliminating this practice is appreciated.

CONTAMINATION

Contamination problems develop from time to time at the C-A. Contamination from working with dispersible radioactivity is possible if you are cutting or grinding an activated item, or if you encounter smoke or liquid spills in a Primary Area.

If you are not trained as a Contamination Worker, then you cannot *work* in areas that are labeled "Contamination Area" or "Radiological Buffer Area". However, you may be escorted by a trained Contamination Worker under certain circumstances. Upon exiting the area you will be "frisked" to check for contamination. If contamination is found, follow the instructions of your escort. The escort will contact the C-A ESH&Q Division Head (x5272, pager 4820), or ES&H Coordinator (x7200, text pager 9-453-5940) and the C-A Health Physics Office (x4660, pager 6189).

Question: does C-A Radiobiology User's Training, the training given here, permit you to work in a primary area that is also a Contamination Area?

Answer: no. In order to work in a primary area that is also a Contamination Area, you must be trained in Contamination Worker Training.

ACTIVATED MATERIALS RULES

Under no-beam conditions, primary and secondary experimental areas normally do not present a significant radiation hazard. Some detectors contain radioactive materials. A few shield blocks on the experimental floor are activated; that is, they have been made radioactive by interaction with the beam. These blocks may be marked with radiation symbols and the word "RADIOACTIVE." ALARA dictates that personnel are aware of ambient radiation levels.

Labels for Shielding:

- Large concrete and steel blocks: colored radiation symbols with the word "RADIOACTIVE" are painted on blocks and plates to indicate the maximum level of radiation 12 inches (30 cm) from any surface:

Green	< 5 mrem/h
Yellow	5 to 100 mrem/h
Red	>100 mrem/h

- Lead bricks, small concrete and steel blocks: the ends of these items are painted with the appropriate color.

At C-A, Users might encounter areas that contain activated materials: 1) the primary areas, 2) Radioactive Materials Areas; for example, the block yard. Small Radioactive materials that cannot be labeled with the words "Radioactive " may be color coded in green, yellow, red, or have a yellow tag attached.

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

ACTIVATION CHECK REQUIRED

- This posting means you **must not** remove and take items from the area without checking activation (residual radiation).
- Contact the HP Office to get an Radiological Control Technician (RCT) to perform the activation check. Users are not qualified to perform activation checks.

- Activation check has nothing to do with checking yourself for contamination.

In order to remove any item from an area posted with the requirement *Activation Check Required,* a person must have an RCT do the Activation Check before removing the object from the area or from your control. Activated equipment must be properly checked and tagged before others handle it at BNL.

NOTE:
Only you can prevent unlabeled radioactive materials from leaving the primary areas. Ordinary items inside primary areas do not bear labels. They could find their way into offices, experimental-areas or waste streams unless you follow the rules.

Any shipments of material off-site must be checked in order to ensure proper packaging and labeling if it is radioactive. Off-site shipping of radioactive materials must be coordinated with the Isotopes and Special Materials Group (x5233).

Question: you wish to remove equipment from an experimental target area to a Radiation Area where you will perform maintenance on it. What do you do?

Answer: call an RCT (x4660) to perform an activation check

Question: what does the posting "activation check required" mean?

Answer: upon exiting this area, personnel must have a RCT check each piece of non-personal equipment that they remove from the area for "activation." Do not confuse this with "contamination check required" which means each person must "frisk" his or her hands and feet to check for loose radioactive material and have a RCT check for dispersible radioactive material.

RADIOACTIVE MATERIAL AREAS

IF you did not bring it into a Radioactive Material Area and you want to bring it out, THEN you must have it checked for activation; e.g., tools you may find.

Many small radioactive parts may be generated inside Radioactive Materials Areas and they will not bear any labels, although the original assembled item may have a label. Only RCTs may release items from these areas.

Question: true or false - only RCTs may monitor and label items for removal from Radioactive Materials Areas.

Answer: true. Contact the RCT (x4660) to make these measurements..

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. This is because most sources are point-like objects. Sources may be stored in shielded containers. Many areas have source storage boxes (painted yellow). 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:

- Please have all sources leak-checked every six months by the C-A HP Office.
- Notify BNL's Isotopes and Special Materials Group prior to shipping a source to or from BNL (Contact the BNL IS&M Group at 631-344-4051).
- Complete the sealed-source inventory form and keep it with the source in the source storage box. Contact the C-A Source Custodian (x5636) for more information.

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. Additionally, you must be a trained and qualified "Source Custodian." Contact the C-A Source Custodian (x5636) for training. The 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. THE FOLLOWING ARE NOT SEALED SOURCES: smoke detectors, exit signs, activated beam-line components, activated shields, radioactive materials in-process such as targets or cooling waters.

If you are not sure about the definition of a sealed source, then contact the HP Office (x4660) in order to make a determination regarding the rules.

The HP Office has custody of a limited number of beta and gamma emitting sources. These are available to be loaned as needed.

Care should be taken to ensure that sources are not lost or damaged, as this might result in unnecessary exposure and widespread contamination. Sources may not be moved

into an uncontrolled area or away from the C-A complex. The HP Office must be contacted if sources are to be moved.

RADIATION SURVEYS AND Chipmunks

RADIATION MONITOR (CHIPMUNK)

Radiation surveys of the experimental floor are made by RCTs. During shutdowns, surveys are done initially, and whenever an RWP is used. Records of the surveys are maintained by the C-A Health Physics Office. During a running period, radiation surveys are updated daily and continuous area monitoring is performed by instruments, called Chipmunks, which alarm in the Main Control Room.

Radiation Monitors (Chipmunks)

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.

If you see a chipmunk blinking red, leave the immediate area, notifiy your collaborators to leave the area, and call the MCR (x4662) 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.
Retrospective exposure rates for any area of interest can be determined by the staff at the C-A HP Office.

There are approximately 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.

RESPONSE TO ABNORMAL RADIOLOGICAL CONDITION

CRASH BUTTONS

- IF the overhead lights go out or are dimmed while you are in the A3 primary areas, THEN hit the crash button since beam is imminent.
- IF a orange strobe light starts to flash and an alarm sounds while you are in the BAF primary area, THEN hit the crash button since beam is imminent.
- Crash buttons are red and mushroom shaped. Doors have crash bars.
- IF you observe a visual warning, THEN, start for the nearest crash button or start for the exit.
- If the lights go out, then do not assume it is a power failure.
- DO NOT PANIC, you have time, 30 seconds minimum.
- Hitting crash buttons or opening doors will turn lights on.

One can always crash into or out of any primary area. Pressing crash buttons or opening access gates from the inside causes the beam stops to insert, lights to go on, and interrupts electrical energy to the main magnet bus and RF devices. Crash buttons are located at several locations in the A-3 beam Line Target Cave and in the BAF Target Cave. They are labeled with a red sign. After pushing a crash button or crash bar, call the MCR and notify them where you are located.

Question: if the light goes out in the A-3 primary area, should it be assumed that loss of electrical power occurred?

Answer: it should be assumed that the lights have dimmed in order to signal that lethal hazards are imminent. You should press the nearest crash button in order to turn the lights on and disable beam.

ABNORMAL RADIATION LEVEL

IF you encounter either of the following conditions:

- Radiation levels not anticipated on your RWP.
- Unexpected high or full-scale reading on a self reading dosimeter.
- Unexpected high or alarming chipmunk.

THEN stop work, leave the immediate area, and alert your Liaison Physicist or Experiment Spokesperson and contact Health Physics (x4660) as soon as possible.

RADIATION SAFETY SERVICES

To Contact Health Physics Office

- Pager 6189 (Digital Pager)
- Phone x 4660

The Radiological Controls Division (RCD) provides the C-A with services that encompass several operational aspects of safety including radiation safety. They provide dose records and radiation surveys, HP coverage for high-dose jobs, and review of RWPs for ALARA. They also assist in re-setting secondary beam lines, and assist in interpreting abnormal radiation levels. If you have radiological concerns that you desire to communicate in writing, you may complete a Radiological Awareness Report available through your Liaison Physicist, or HP representative.

During running periods, HP 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 HP Office (x4660), or pocket pager 6189 (digital pager), or by contacting the C-A MCR (x4662).

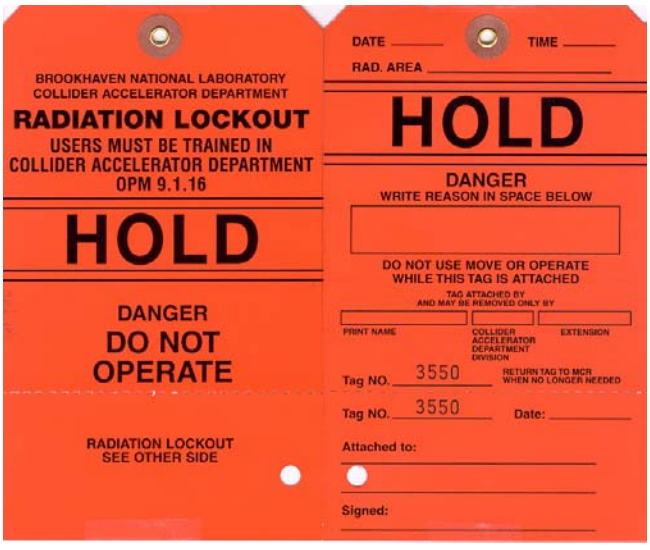
Special shifts for RCTs may be pre-assigned allowing for specific round-the-clock coverage when needed.

LOCKOUT-TAGOUT

Lockout/tagout (LOTO) is used everywhere at the Laboratory for personnel safety for energy sources. You recognize it by the presence of a red tag, or a orange tag, and a lock. In some cases, the equipment cannot be locked and only the 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. To prevent accidental radiation exposure, electrical shock or other hazards from different sources of energy, the individual who attached the LOTO shall be the only person to remove the LOTO. Contact the MCR or the C-A ESHQ Division Head (x 5272) if you need to remove someone else's LOTO.

The follow rules apply to LOTO:

- Program disruption and/or electrical shock may occur by overlooking a warning tag.
- Tags and signs are often placed only on the front of equipment.
- Look at the front of equipment before starting work.
- DO NOT alter or otherwise tamper with equipment that bears a LOTO tag or a Orange Warning Tag.
- DO NOT MOVE, ENERGIZE, OR DENERGIZE, any tagged item. This may compromise their effectiveness.



Radiation Safety LOTO Tag

Access Security System Orange Warning Tag.

Question: a red tag is on a piece of equipment. You need to operate the equipment, what do you do?

Answer: contact the MCR (x4660)

INTERLOCK BYPASS

- Never take it upon yourself to bypass any interlocked system.

Interlock bypassing can only be done at the discretion of the C-A Radiation Safety Committee. Proper authorizations must be obtained prior to the bypass. The protection offered in lieu of the interlock must be equivalent. This requirement is met by having the pertinent Liaison Physicist and the Radiation Safety Committee Chair review and approves the bypass.

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).

COMPRESSED GAS SAFETY

GENERAL RULES FOR CYLINDER HANDLING

The best method of handling compressed gas cylinders is to have BNL personnel handle the cylinders for you. This can be arranged through your Liaison Physicist or Engineer. If you must handle a compressed gas cylinder keep the following precautions in mind:

- 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 name of assigned user on tag indicating the cylinder is in use

DELIVERIES TO C-A FACILITIES

In recent years, the delivery of materials to C-A has become complicated due to our attempt to comply with Price Anderson Act Amendments. Under Price Anderson, we are required by Federal law to obey all radiation safety rules or face stiff penalties if we do not. All persons, including delivery people, who enter Radiation or Controlled Areas either must wear a TLD, be properly trained, or be escorted by a trained Radiation Worker. To ensure that DELIVERY PEOPLE DO NOT ENTER POSTED AREAS, the department requires that all deliveries to the C-A complex be made to **Building T 100**.

Arrangements can be made with the Main Control Room, ext. 4662, for off-hour deliveries. When the delivery is made to the MCR, personnel there will then contact the addressee.

Under no circumstances are deliveries to be made to other buildings in the C-A complex without approval of the C-A ESH&Q Division Head (x5272, pager 4820) or ESH Coordinators (x7036, text pager 9-453-5940).

WHEN PLACING AN ORDER, INFORM VENDORS TO PUT YOUR NAME ON THE PACKAGE (packages arriving without a NAME will be sent back) AND STATE THAT DELIVERIES ARE TO BE MADE TO **BUILDING T 100.**

Individuals transporting biological materials to and from the BNL site must comply with protocols set forth from the Medical and Biology Departments. All transfer of biological materials to and from the C-A experimental facilities must use Laboratory Animal Care Vehicles or Government Vehicles.

IF YOU ARE SHIPPING ITEMS OFF SITE ASK YOURSELF THESE QUESTIONS

IS THE ITEM RADIOACTIVE?
To check if items are radioactive contact Health Physics x 4660. Radioactive Materials must be shipped through the *Isotope and Special Materials Group* x 4051.

DOES THE ITEM CONTAIN HAZARDOUS MATERIAL?
Contact C-A Environmental Coordinator x 7520 or C-A Hazardous Waste Manager x 7520.

DOES THE ITEM CONTAIN BIOLOGICAL MATERIALS?
Contact Experimental Spokesman (Marcelo Vazquez) x 3443.

STILL UNSURE ON HOW TO SHIP MATERIAL ON OR OFF SITE?
CONTACT YOUR LIASION PHYSICIST (Adam Rusek) x 5830

STOP WORK IMMINENT DANGER PROCEDURES

This procedure provides a policy and process to stop work at BNL to mitigate ***imminent danger*** to personnel, equipment or the environment. ***Imminent danger*** exists when there is a hazard that could result in death, serious injury, environmental impairment or significant damage, and when **immediate action is required**. The person issuing the stop-work order makes determination of the need for immediate action.

Anyone who will be given unescorted status in a facility must first be trained in this procedure. **Only persons trained in this procedure have stop-work authority**. For example, casual visitors to BNL and other untrained individuals do not have this stop-work authority. Persons who are not trained for unescorted access are still expected to call attention to any questionable or unsafe act or condition. Management shall take such notification seriously and make an evaluation.

Laboratory managers and supervisors shall not allow hazardous work to be started unless the involved worker(s) are trained and qualified in this stop-work procedure.

BNL functional organizations on the BNL Organization Chart (e.g., Departments, Divisions, Offices, Projects, etc.) shall be referred to as Departments for the purpose of this procedure.

Persons trained in this procedure are responsible for and expected to issue a Stop-Work order for ***imminent danger*** whenever it is observed. Each Department shall train all staff under their direct supervision in the provisions of this procedure. If an employee is reassigned to work for another supervisor for a period of time, the new supervisor must ensure facility specific stop-work training is conducted prior to allowing work to commence. Each Department is responsible to integrate and document stop-work training for employees, guests, and users who will be granted unescorted access within facilities under their purview. The training shall include discussion of applicable Department-specific stop-work examples of ***imminent danger***.

Requests to change this procedure must be forwarded to the BNL Laboratory Director.

This procedure is used to stop work when conditions that are interpreted to constitute imminent danger occur. **Other procedures shall be used to prevent people from taking unnecessary risks with lesser hazards or for stopping radiological work.**

Any person who reasonably concludes that an ***imminent danger*** exists and that immediate action is required to mitigate the danger is obliged to take action to stop work. An ***imminent danger*** exists if proceeding with work could result in death, serious injury, or significant unexpected environmental or equipment damage. A person who concludes that an ***imminent danger*** exists must consider whether stopping work immediately or proceeding to a safe stopping point constitutes the greater danger.

Procedure

1. The initiator of a Stop-Work order for ***imminent danger*** shall state the following:
   "Stop work! You are in imminent danger because…"
2. Any person receiving a Stop-Work order shall stop work immediately, if that can be done safely, or at the first opportunity to stop safely.
3. The person issuing a Stop-Work order MUST NOT verbally or

physically interfere, whether or not the recipients of the Stop-Work order continue to work.

4. After the work is stopped, the recipient of the Stop-Work order shall notify his/her supervisor (Liaison Physicist) and his/her ES&H Coordinator that a Stop-Work order was issued, and of the nature of the ***imminent danger*** that exists.

Notifications

The person initiating a Stop-Work order shall identify him/herself to the affected workers as soon as it is safe to do so. In turn, the supervisor of the involved work shall notify his departmental management.

If the person issuing the Stop-Work order feels that the recipient(s) of the order failed to take appropriate action, then the initiator of the Stop-Work order shall notify his/her own supervisor (Liaison Physicist) and the C-A ES&H Coordinator (x7200, text pager 9-453-5940). If more than one Department is affected by the Stop-Work order, then the person initiating the Stop-Work order shall notify the C-A ES&H Coordinator.

The supervisor and the ES&H Coordinator shall investigate and evaluate the need for further action or internal or external reporting. Management shall resolve appropriate issues in cases where the recipient of a stop-work order is not compliant with this procedure. There will be no reprisals by anyone for issuance of a stop-work order.

Following a stop-work order, the C-A Department Chair or designate shall determine, with advice and counsel from ES&H personnel, the conditions that must be met before work may resume. Input into conditions for restart shall also be sought from the person who initiated the stop-work. Work shall not be resumed until appropriate corrective actions and safety reviews are completed and the responsible manager authorizes restart.

RADIOLOGICAL STOP WORK PROCEDURE

This procedure provides a mechanism for trained Laboratory employees, guests, and contractors to stop radiological work that does not meet Laboratory requirements or creates the threat of radiological exposures or releases. The Laboratory has issued a procedure for stopping work when conditions constituting "Imminent Hazard" exist. This radiological stop-work procedure utilizes the requirements and process established in the imminent hazard procedure fully, except that different criteria are described for the conditions under which a radiological stop-work order may be given. Because of the nature of radiological work, stop-work criteria are provided for certain situations that would <u>not</u> be considered "Imminent Hazard."

Improvement of radiological performance is a high priority at BNL. All workers trained in the radiological stop-work procedure have the responsibility to improve performance by providing careful attention to his/her performance and to that of co-workers. In support of this procedure:

- Each worker is expected to point out and insure correction of poor radiological work practices whenever they occur. In most cases, all that should be necessary is calling attention to the problem.
- All workers are expected to respond positively to radiological cautions provided by a co-worker.

- There may be situations where a formal stop-work is necessary. Any worker trained on this procedure is authorized to stop radiological work when the conditions defined in the Section below are met.
- All personnel are expected to immediately abide by a stop-work instruction.

It should be noted that the supervisors (Liaison Physicist) 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.

Whenever poor radiological performance is observed, workers should provide immediate advice to correct the problem**.** In most situations, a formal stop-work is not needed. The concern should be addressed quickly without participation and review by other than the involved workers. The imminent occurrence of the following examples are the types of situations that should be immediately corrected with a cautioning:

- Entry into a Controlled Area without proper training or escort.
- TLD worn on the wrong location on the body.
- Work about to begin without observing expected requirements.
- Removal of material without observing exit survey requirements from a location controlled as a Contamination or Activation Area.
- Beginning work without adequate Work Planning or training qualification.
- Touching the face or other exposed skin while working in a contamination area.
- Survey for radioactivity performed in a hasty manner.
- Disturbance of radiological postings or barriers.

Each of these activities, if not promptly addressed, could lead to a violation of federal and BNL radiation protection requirements.

IV. Stopping Radiological Work

1. Many poor practices can be quickly corrected through the cautioning process before violations occur. There may be occasions when an employee observes a practice that is most likely a violation already, or possesses the potential to result in significant radiological exposure or release of radioactive material. In these situations, the work should be immediately stopped through a formal "Stop-Work" order; and follow-up reviews conducted to correct the problem prior to work continuing.

   Examples of this type of situation are:

   - Discovery of work that is being conducted without adequate Work Planning, such as work in a High Radiation Area or a Contamination Area without a RWP.
   - Blatant or repeated disregard of established radiological requirements or direction from a health physics technician.
   - Operation of radiation-producing equipment with

interlocks bypassed without prior review and approval.

- Radiological controls that are inadequate for work in progress as evidenced by:
- Unplanned exposures greater than 25 mrem to a visitor or minor, or greater than 100 mrem to a worker.
- Two or more skin contaminations during any single phase of the work.
- Any single skin contamination >50,000 dpm/100cm^2

In these situations, the work should be stopped by any trained individual using the following language. "**Stop work. You are in violation of radiological requirements because ……"**

2. When a stop-work order has been given, the following actions shall occur:
3.

- All work in the affected activity shall stop as soon as possible.
- The work place shall be placed in a safe condition.
- All workers shall report to the responsible line manager.
- Work shall not resume until appropriate safety reviews are performed and the C-A Department Chair or designee, subject to the advice and counsel of the affected ESH Coordinator (s) and the BNL Radiological Control Manager, authorizes restart.

COUNTER-INTELLIGENCE PROGRAM

The Department of Energy is known worldwide as a stronghold of scientific expertise, and as such, is of prime interest to foreign intelligence services. To help protect it's interests, the DOE established the Counterintelligence Program. All BNL employees are required to report contacts with foreign nationals and all travel to sensitive countries. For information about this program or to report any concerns contact the BNL Counterintelligence Program Manager (x2234).

LABORATORY COMPUTERS

Laboratory computers are provided to staff in order to support Laboratory operations. You must be authorized to work on a computer and use it in accordance with BNL requirements. The BNL Computer Users Agreement defines the acceptable parameters for computer use.

You are responsible for the security of your computer and its stored data. Information created, stored, and processed at BNL is considered BNL property and must be protected. If at any time, you suspect that the security of your computer has been compromised, contact your supervisor immediately.

BNL SECURITY

The Police Group, part of BNL's Safeguards and Security Division, is responsible for providing protection to BNL employees, property, and equipment, as well as controlling sensitive and classified information.

Identification badges, security clearances, and property passes aid in the security process. Photo identification badges are issued to all employees, visitors and guests. ID badges should not be left in the open. If you loose your ID badge contact the Security Division to have another issued.

A property pass is required any time you remove BNL property from the site. BNL reserves the right to inspect and search vehicles entering or leaving the site. For more information about security or if you are required to work with sensitive material contact Security Division (x2238)

STAFFING LEVELS AND SAFETY

Rules shall be followed even when you are short-handed. Do not violate safety rules to get the job done. For example, do not go down one-way streets the wrong way even if you get to the beam-line quicker. Do not climb cable tray because it takes more time to ask for a man-lift. Do not use a procedure that you have not been trained on even if you feel it will please your Experiment Spokesperson. IF you were called in unexpectedly and you were not physically or mentally ready to work, THEN you must request the next person on the call down list be contacted. In short, there are no economics for safety. It will always be cheaper to do the job right the first time. There is only a cost for failure, and experience shows this cost can be spectacular.

OUTDOORS SAFETY CONCERNS

All New York State laws must be followed. The site speed limit is 30 mph. Obey all parking and traffic postings. The deer on site also present a driving hazard to which you should be alert.

On the BNL site you will see a variety of wildlife. Many of the deer and some other animals carry the deer tick, which can transmit Lyme disease. Avoid high grass and wet wooded areas. For more information about Lyme disease contact the C-A ES&H Coordinator (x 7200, text pager 9-453-5940) or the Occupational Medicine Clinic.

FIRE OR OTHER EMERGENCY

IF you enter into a primary area or experimental area, THEN make a mental note of:

- Exits.
- Fire Alarm Pull Boxes.
- Crash buttons.
- Crash cords.
- Emergency exhaust control location.
- Telephones

In any emergency, such as fire or medical emergency, you are to pull a fire alarm box

and telephone the Fire/Rescue Group (x 911 or x2222). Fire alarm boxes are located throughout the accelerators and at the entrances to target caves. This is the best method to simultaneously alert MCR and the Fire/Rescue Group. Pulling a fire alarm box brings the Fire/Rescue Group to your specific alarm-box location within two minutes, and appropriate additional personnel can be summoned right away.

Primary areas and target caves are of limited space. If fire should break out, then smoke could quickly impair visibility, and asphyxiation from smoke is a possibility. If fire breaks out, then get out immediately. Emergency exit signs will point you to the nearest exit.

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.

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

Answer: Pull a fire alarm box and call x2222 or x911. This response will make it easier for the Fire/Rescue Group to quickly determine your location, and you simultaneously alert the C-A MCR and the BNL Fire/Rescue Group.

Question: there is a fire near your detectors, what do you do?

Answer: warn others, pull the fire alarm box and evacuate the building.

AGS and BAF EMERGENCY SIGNALS

Even if you are inside an AGS/BAF primary area, then you must obey the emergency signals as follows:

If you hear a Pulsating AGS Klaxon (flammable/explosive gas alarm), Intermittent or Continuous Fire Alarm Bell, evacuate the area after placing equipment in a safe operating mode. Wait at least 50 feet from the entrance to the building. Do not reenter the building until you have received instructions from the Fire Captain or Local Emergency Coordinator that conditions are safe to reenter the building.

BNL SITE SIRENS

The site evacuation plan covers other facilities on-site. The site sirens are tested each Monday at noon. If you hear a continuous site siren for five-minute duration, then assemble at the indoor assembly area.

- For the A-3 line, the Indoor Assembly Area is located in the Lobby of building 911.
- For BAF the Indoor Assembly Area is located in the Control Room at the LINAC, building 930, on the second floor.

IF you hear a pulsating site-wide siren, THEN evacuate the BNL site.

Question: if you hear the intermittent fire alarm or a pulsating AGS klaxon, then what should you do?

Answer: assemble in the lobby of Building 911.

Question: continuous sounding of the site sirens for five minutes means what?

Answer: For Users at the A3 beamline proceed to the lobby of Building 911. For Users at BAF proceed to the lobby of building 930 (LINAC).

ACTIONS FOLLOWING AN INJURY/ILLNESS

IF there is an emergency involving a serious injury or an illness such as a heart attack, THEN pull the fire alarm box, and call x2222 or x911.

IF you are injured and require first aid during normal work hours, then report as soon as possible to the BNL Industrial Medicine Clinic, which is located in Building 490. You can go to the Firehouse for first aid during off hours. Contact your Experimental Spokesperson or Liaison Physicist if possible, to accompany you to the clinic.

ACCOUNTABILITY FOR NOT FOLLOWING THE RULES

Perform exactly the requirements in C-A procedures. This policy applies to all Users and will be enforced everywhere. You will be held accountable to follow rules and procedures for which you have been trained.

FREQUENTLY ASKED QUESTIONS AND ANSWERS

The answers to these questions provide limited guidance and they are intended to help you plan your experiment at C-A. Consult your Liaison Engineer or Liaison Physicist for more detailed information.

Do I really need to hang my TLD badge up every day?

Yes. TLD badges are required to be left at the assigned station or badge board at the end of the workday, and must not be taken outside the Laboratory. TLD storage racks are located in low-background areas in Building 911 near the C-A Training Office. If you leave your TLD badge at the work area or the counting house instead of using a

rack, then unwarranted dose may be recorded.

Ninety per cent of the lost badges have been as a result of C-A experimenters taking them off-site and not returning them, especially at the conclusion of an experimental run. Getting used to putting the badge on the rack at the end-of-shift will help alleviate the problem of un-returned badges.

Does a senior User have to be present during every shift?

During beam operations, all shifts must be staffed by at least one person experienced in operation of the experiment. He or she shall be aware of proper response to alarms and for normal maintenance actions such as change-out of gas cylinders, and alarms for emergency actions. Emergency actions may include closing-off flowing gas or cutting power. Senior Users should also be aware of access controls for the experimental area and operations procedures for the gas-mixing systems if appropriate.

Do Users need to have written procedures?

The C-A Department conducts its operation using formal written procedures in a style prescribed by DOE Orders. DOE currently desires uniform operations through out its facilities but recognizes that Users must apply a graded approach commensurate with the hazards and programmatic importance of their experiment. Users at C-A should write down all procedures or protocols with safety implications such as mixing flammable gases, opening/closing vacuum window shutters, or the actions to be followed in an emergency.

In addition to written procedures, the experimental areas should be orderly and clean at all times. Keep all gas lines, power lines and water lines labeled and in separate raceways. Label all containers of liquids. Keep combustible materials to a minimum.

Do all changes to an experiment need to be brought before the C-A Experiment Safety Review Committee?

Inform the Liaison Physicist about <u>all</u> changes to the experiment. The Liaison Physicist will know if further review is needed. In addition to keeping the C-A informed, you should share knowledge about the rules with all members of the collaboration. For example, all Users should be aware of any local actions to be followed in response to a fire alarm. They should know of hazards associated with the experimental equipment such as vacuum windows, enclosed spaces or pressurized devices. Additionally, Users should be aware of the harmful nature of any hazardous materials in use.

Should Users assume the safety committees have made the experiment safe, or should Users continue to minimize hazards?

It is preferable to engineer all hazards out of an experiment. The C-A Department safety review committees try to ensure that safe or acceptable configurations are planned. In some cases, the plans are not followed or subtle hazards appear after the experiment is built.

If you feel some area or apparatus or practice is not safe, then say so. The C-A management will back you up and investigate.

Are there special permits required to emit gases from detectors or experiments?

The C-A has been reviewed for air-permit release-points by New York State. Prior to each experiment, the C-A Experimental Safety Review Committee and the Liaison Physicist must review the gas flows for all the experiments. For any release, the Liaison Physicist must submit a completed Effluent Evaluation Form in order to check the need for a permit.

LIST OF ACRONYMS

AGS - Alternating Gradient Synchrotron
ALARA - As Low As Reasonable Achievable
BAF - Booster Application Facility
BNL - Brookhaven National Laboratory
BSA – Brookhaven Science Associates
C-A – Collider Accelerator
CAS – Collider Accelerator Support
DEC - Department Emergency Coordinator
DOE - United States Department of Energy
EP&S - Experimental Planning and Support
ES&F – Experimental Support and Facilities Division
Division, a Division of the AGS Department
FEB - Fast Extracted Beam
HP - Health Physics
LEC - Local Emergency Coordinator
LOTO - Lock Out Tag Out
MCR - Main Control Room
OC - Operations Coordinator
ODH – Oxygen Deficiency Hazard
OSHA - United States Occupational Health and Safety Administration
PAAA – Price Anderson Act Amendments
RCD – Radiation Control Division
RCT- Radiological Control Technician
RHIC - Relativistic Heavy Ion Collider
RWP - Radiation Work Permit
SEB - Slow Extracted Beam
SRD - Self-Reading Dosimeter
TLD - Thermo-Luminescent Dosimeter