BROOKHAVEN NATIONAL LABORATORY

Procedure: C-A-OSH-SHP
Revision: 00
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COLLIDER-ACCELERATOR DEPARTMENT

Title: OSH Initial Assessment Review for Accelerator Shops

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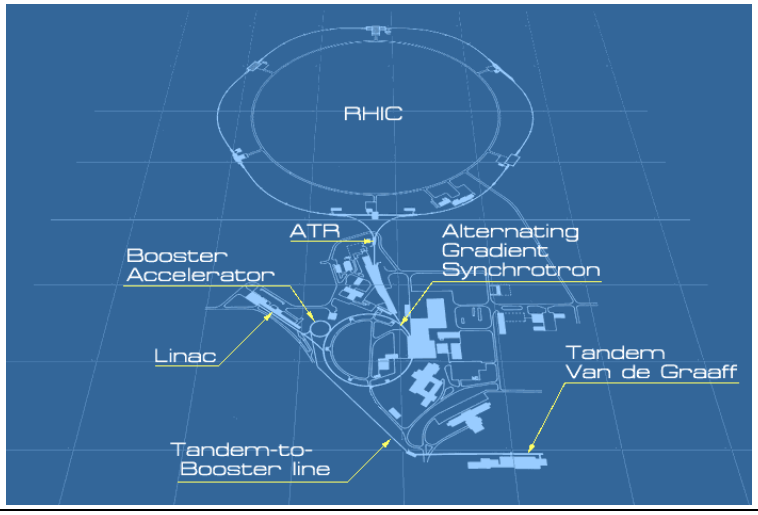
BROOKHAVEN NATIONAL LABORATORY
INITIAL ASSESSMENT FORM

ID:	C-A-OSH-SHP	Revision 00	
Work Area Name:	Accelerator Shop Facilities		
Work Area Description:	AGS, LINAC, TVDG, Booster, and RHIC Shop Facilities. 		
Dept./Div.:	Collider-Accelerator Department (C-AD)		
Dept. Code:	AD		
Building(s):	820, 901A, 911, 912, 912A, 919, 919A, 919B, 922, 923, 925, 928, 929, 930, 933, 933A, 933B, 939, 940, 975, 1002A, 1005S, 1006, 1008, 1008A, 1010.		
Point of Contact:	Refer to C-AD Building Manager Listing http://www.cadops.bnl.gov/AGS/Accel/SND/buildingmanagers.htm		
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General Information for Accelerators and Experimental Areas

The accelerator shops are primarily used for assembly, repair and rework activities in support of accelerator operations. Personnel utilizing these facilities are trained to perform technical tasks in accordance with their Job Training Assessments (JTA). In addition to training, paying "Attention to Detail" when performing daily shop activities not only enforces C-A commitment to safety but reduces the chance of having an accident. To avoid unnecessary down time, the accelerator shops are reasonably located close to the facility they support. In addition, each accelerator shop has a Group Leader/Technical Supervisor assigned to the area to support personnel while performing their assigned tasks.

The following occupational safety and health hazards directly influence Collider-Accelerator shop area activities: hazards posed by heavy objects, mechanical equipment, electrical systems, magnetic fields, toxic or flammable materials, ionizing radiation, non-ionizing radiation and fire.

Detailed Process and Hazard Descriptions for Accelerator Shop Areas

IONIZING RADIATION HAZARDS

External radiation hazard is not a common hazard for shop personnel. However, if shop personnel are required to work on activated material, work controls and job-specific radiation work permits would require appropriate shielding and/or barriers such as fences to maintain a safe working environment to ensure ALARA concerns are addressed.

Accidental exposure of workers to contamination is rare and may happen if working on activated material. Because there is a relatively minor inventory of dispersible radioactivity in a shop area, there is no impact to public. That is, experience shows the majority of radioactivity will be firmly entrained in the materials and will not become airborne. The experience with past contamination events is that the severity of contamination is negligible. That is, significant internal exposures to radioactive materials have not occurred over the past 40 years of operations at C-A facilities.

The C-AD has a limited number of beta and gamma emitting sources. These are available to be loaned as needed. Care is taken to ensure sources brought into the C-AD facilities are not lost, as this might result in unnecessary exposure and widespread contamination if a source is damaged. Sources are not allowed to be taken into an uncontrolled area such as a clean shop nor away from the C-AD complex. The C-AD HP Office is contacted if sources are moved within the complex. Sources owned or brought into the complex are leak checked by the HP Office annually, or a valid certificate of a leak check accompanies the source.

HAZARDOUS OR TOXIC MATERIAL HAZARDS

In any handling operation, routine industrial hygiene procedures are followed. In case of fire, some lead may be heated and released in smoke. Shop personnel are trained to stay out of smoke if a fire occurs, thus exposure to lead vapors is not considered a routine hazard.

Personnel who work with hazardous chemicals use materials Safety Data Sheets (MSDS). Personnel are also trained in Hazard Communication. The range of materials is typical for an industrial complex of this size. The hazards from these materials are in the “routinely accepted” category and pose minor hazards within the shop complex. In particular, hazardous and toxic materials pose no significant impact off-site.

It was concluded that toxic hazard from an airborne release of toxic materials in a shop is low. Hazardous or toxic materials are not normally “in process” in shops; for example, there is no grinding of beryllium or smelting of lead. Studies show airborne radioactive material from cutting or grinding activated materials is not a significant hazard. Workers are trained not to eat in shop areas. The probability of internal injury or significant internal radiation dose due to work in any accelerator shop area was determined to be extremely remote. That is, the probability of occurrence could not be distinguished from zero.

FLAMMABLE OR COMBUSTIBLE MATERIAL HAZARDS

Welding gases and flammable/explosive gases in accelerator shop areas are widely used and stored according to National Fire Protection Association codes and standards applicable to experimental installations. Gases are stored in compressed gas cylinders, which meet DOT specifications. Large quantities of stored gas are not permitted in accelerator shop areas, and staff and users are generally limited to using 100 to 200 lb. cylinders inside of buildings. No offsite threats to the public are expected should a cylinder fail.

Combustible loading consists of beam diagnostic and testing equipment, shop tools such as drill presses and lathes, magnets, power cables and control cables. None of these materials are highly flammable, and are expected to self extinguish upon de-energizing of electric power. No off-site threats to the public are expected from a fire.

The personnel risks associated with the fire hazard are considered low due to the type of building construction, the available exits, the fire detection systems, the fire alarm systems, and the relative fire-safety of the components and wiring. The fire protection of some accelerator shop buildings is improved by the installation of sprinkler systems. Emergency power and lighting is available in all parts of the accelerator complex and travel distances to exits do not present a problem.

The maximum travel distance from any point to an exit is less than 300 feet and therefore within the allowable distance. Sprinklers are installed in some accelerator shop facilities. Smoke alarms, fire pull stations, on-site fire/rescue department, emergency lighting, nonflammable construction and low-hazard fuel loading make the shop structures acceptable.

ELECTRICAL ENERGY HAZARD

Hazards leading to personnel injury include electrical shock and high current arcing. Electrical shock presents the greatest shop hazard. High voltages are present in many parts of an accelerator shop complex. These areas include AC distribution systems from 480 V 3-phase down to the 208/120-volt local distribution systems.

Regardless of the voltage involved, high current systems may create arcs capable of causing severe flash burns, direct burns, or molten metal splattering. Even though circuit breakers may actuate, the short-circuit capability of many systems is many tens of thousands of amperes and severe damage or injury can occur before the breaker trips.

Procedures and proper equipment design are used to reduce the potential for electric shock. Accidents are eliminated or minimized by the application of proper equipment design and design reviews, quality assurance programs, component and equipment testing and personnel training.

Electrical hazards pose only minor on-site impact potential and negligible off-site impact potential.

OXYGEN DEPLETION HAZARDS

Oxygen depletion hazards (ODH) were reviewed and found not to apply to accelerator shop areas. The only scenario that may be considered is cryogenic dewar usage. However, based on training requirements on the use of dewars this is not a concern at this time. There is no impact on the public or the environment for ODH.

MAGNETIC FIELD AND ELECTROMAGNETIC RADIATION HAZARDS

High direct-current magnetic fields may be present in accelerator shop areas during testing tasks. Limits of exposure are such that the whole body is not allowed in fields greater than 600 gauss on a daily basis (8-hour time-weighted average), and the extremities are not allowed in fields greater than 6000 gauss (8-hour time-weighted average). Other hazards associated with strong magnetic fields are reaction with heart pacemakers or other medical implants and the potential physical injury of carrying ferrous objects near a strong field. However, areas with strong magnetic fields are fenced and posted with appropriate warnings. Cardiac pacemaker wearers are not allowed to be exposed to fields greater than 5 gauss.

High magnetic fields are routinely encountered by the public in conjunction with Magnetic Resonance Imaging. Lower level magnetic fields are routinely encountered in the home due to AC power use.

Some shop areas may contain high power rf systems that generate large fields of electromagnetic radiation in the frequency range of a few hundred kilohertz to a few hundred megahertz. These systems are thoroughly shielded to prevent leakage radiation, thus minimizing this hazard. Use of RFI gaskets controls leakage of radio-frequency radiation from electronic equipment. In addition, these areas are protected by local barriers to restrict personnel access.

Exposure of personnel to magnetic fields and rf radiation is in compliance with SBMS requirements. There are no off-site or environmental impacts associated with magnetic fields and electromagnetic radiation at the ion accelerators.

THERMAL ENERGY HAZARDS

Heat sources such as soldering irons and vacuum heating blankets exist in several accelerator shop areas. Skin contact with heat sources may cause burns. These hazards are mitigated by safety reviews and compliance with SBMS requirements; for example, shielding or posting warnings near hot surfaces. This hazard is limited in scope and poses no hazard outside the complex.

CRYOGENIC TEMPERATURE HAZARDS

Cryogenic liquids exist in several shop areas of the accelerator complex. Skin contact with cryogenic materials due to spills or splashes may cause freezing or "cryogenic burns." These hazards are mitigated by safety reviews and compliance with SBMS requirements; for example, requiring the use of gloves and splash goggles when handling open containers of cryogenic fluids. This hazard is limited in scope and poses no hazard outside the complex.

KINETIC ENERGY HAZARDS

Kinetic energy hazards are associated with motorized materials handling equipment and with the operation of hand and shop tools. These hazards are mitigated by safety reviews and compliance with SBMS requirements; for example, machine guarding. This hazard is limited in scope and poses no hazard outside the complex.

POTENTIAL ENERGY HAZARDS

Potential energy hazards are those associated with vacuum vessels and compressed gases, as well as those associated with hoisting and rigging operations. These hazards are mitigated by safety reviews and compliance with SBMS requirements; for example, by designing pressure vessels to the ASME code, setting lifetimes and replacing vacuum windows, and by setting requirements for the training and qualification of operators, riggers, inspectors, and trainers who use cranes, forklifts, man lifts, hoists, in-plant powered industrial trucks, and rigging equipment.

This hazard is limited in scope and poses no hazard outside the complex.

Controls in-Place or Planned Controls

IONIZING RADIATION HAZARDS

A. Direct Radiation

Possible Consequences:

- Accidental external radiation exposure from activated material
- No impact to public

Potential Initiators:

- Failure to follow procedures or instructions on an RWP
- Loss of configuration control
- Barrier failure
- Person defeats barrier
- Failure to respond to radiation alarms

Hazard Mitigation:

- Shielding, fencing and barrier inspection by workers and RCTs
- Periodic radiation surveys of the work areas by RCTs
- Facility specific training for all personnel and Users
- Formal job assessments
- Conduct of Operations procedures and training records
- PAAA enforcement
- A system of radiation work permits
- Radiation Worker training
- Work planning

B. Contamination

Possible Consequences:

- Accidental exposure of workers to contamination
- No impact to public

Potential Initiators:

- Failure to follow the procedure or the RWP if applicable
- Failure to follow rules for entry or work in Contamination/Activated Area

Hazard Mitigation:

- ALARA Committee review of tasks that generate airborne radioactivity
- Workers trained on equipment and procedures
- Formal job assessments
- Conduct of Operations procedures and training records
- A system of radiation work permits
- Contamination Worker training as applicable
- Work planning

HAZARDOUS OR TOXIC MATERIAL HAZARDS

Possible Consequences:

- Accidental exposure leading to personnel injury
- Un-permitted environmental release
- Negligible off-site impact

Potential Initiators:

- Oil leak from capacitors, transformers, pumps, motors
- Unsafe practices for handling hazardous and toxic materials

Hazard Mitigation:

- Approved line organization procedures and training for hazardous waste handling
- Hazard Communication training
- Annual inventory of chemical and hazardous materials
- Annual inventory, inspection and tracking all PCB containing devices
- Specific hazard training (e.g., Beryllium, asbestos)
- Limiting the amount of hazardous materials in process
- Work planning

FLAMMABLE OR COMBUSTIBLE MATERIAL HAZARDS

Possible Consequences:

- Loss of life or severe injury
- Damage to components or shop facilities
- Impact on the physics program due to fire-related interruptions
- Insignificant impact on the environment due to releases as a result of fire

Potential Initiators:

- Damaged or improperly connected electrical cables
- Improper fusing of electronics boards or failed motor starter circuits
- Cutting and welding and not following SBMS requirements
- Ignition of flammable gases in the shops
- Ignition of flammable liquids in the shops

Hazard Mitigation:

- Sprinklers or other protection systems for high-value shop equipment
- Selection of materials that reduce the potential for flame spread
- Emergency exhaust ventilation systems
- The use of strategically located exits and audible alarms to reduce the potential for loss of life during an emergency
- Elimination of potential ignition sources in shop areas
- On-site fire/rescue organization
- Emergency planning and drills
- Limits on flammable gas or liquid inventory
- Requirements for safety review of shop modifications
- Compliance with the Life Safety Code, NFPA 101, Chapters 1-6
- Compliance with the DOE Orders 420.1A, Facility Safety, and 440.1A, Worker Protection Management for DOE Federal and Contractor Employees
- Electrical energy interlocks tripped by heat or smoke detectors
- Regular maintenance of electrical equipment
- Using containers that meet the criteria of Underwriters Laboratories or Factory Mutual for flammable materials
- Identifying and posting hazardous locations for flammable or combustible materials storage or use

- Written procedures to temporarily impair fire detection or fire protection systems
- Using a fire watch and a permit for cutting and welding activities
- Work planning

ELECTRICAL ENERGY HAZARD

Possible Consequences:

- Electrocution death and injury
- Electrical arcing and molten-metal spray injury
- No impact to public

Potential Initiators:

- Unsafe practices

Hazard Mitigation:

- Approved line organization procedures and training for specific tasks involving electrical safety issues
- Control zones around energized parts with signs and barriers
- Procedures and training
- Use of permits to work hot
- Performance of a job safety-analysis in order to identify and mitigate the hazard of electrocution
- Lock out and tag out procedures
- Equipment and training to isolate the source of energy in the system
- Use of a safety watch or two-man rule where appropriate
- Not allowing Users to work on power distribution or to connect wiring directly to electric power
- Work planning

MAGNETIC FIELD AND ELECTROMAGNETIC RADIATION HAZARDS

Possible Consequences:

- Reaction with medical implants
- Magnetic pull of heavy metal object through persons hand with resultant crush type-injury of hand
- Hyperthermia (rf)
- Cataracts (rf)
- Lenticular opacities (rf, laser)

Potential Initiators:

- Inadvertent exposure to stray magnetic field
- Exposure to rf radiation from rf device
- Unprotected eye exposure to laser light

Hazard Mitigation:

- Areas with routine strong magnetic fields are fenced and posted with appropriate warnings
- Temporary fencing and posting are located appropriately during measurement of magnetic fields in shop areas
- Design reviews and functional testing are performed before operations
- Doors to the facilities are posted with warnings for persons wearing a cardiac pacemaker
- Local barriers are placed around rf stations in accelerator shops
- RFI gaskets are used on equipment to prevent rf radiation leakage
- Routine monitoring for rf radiation to determine if gaskets are effective
- lasers are equipped with interlocks and certain classes of lasers have enclosed beams
- Eye protection is required during operations with certain classes of lasers
- Eye exams are required prior to using certain classes of lasers
- Work planning

THERMAL ENERGY HAZARDS

Possible Consequences:

- Burns
- Fires

Potential Initiators:

- Contact with hot surfaces of machinery
- Contact with soldering irons
- Improper protective clothing for cutting and welding operations

Hazard Mitigation:

- Posting and guarding hot surfaces
- Review of installation and operating procedures by the safety committees
- Design reviews and functional testing before operations
- Cutting and welding conducted by trained personnel only
- Boundaries for cutting and welding are posted
- Cutting and welding permit
- Work planning

CRYOGENIC TEMPERATURE HAZARDS

Possible Consequences:

- Burns

Potential Initiators:

- Spills of cryogenic liquids

- Contact with cold lines associated with liquid nitrogen or other cryogenic fluids

Hazard Mitigation:

- Insulation on cold surfaces
- Review of installation and operating procedures by the safety committees
- Design reviews and functional testing before operations
- PPE such as goggles and face shields
- Work planning

KINETIC ENERGY HAZARDS

Possible Consequences:

- Physical injury (e.g., eye injury, broken bones, hearing loss, fatal injury, etc.)

Potential Initiators:

- Mis-operation of power tools
- Pressure testing with inappropriate equipment
- Inadvertent contact with rotating or moving machinery
- Improper rigging of apparatus or shielding

Hazard Mitigation:

- Machine guards
- Only trained personnel allowed to operate shop tools or perform rigging operations
- Written procedures or supervisory participation in large equipment moves or pressure tests
- Critical lift review and approvals as per SBMS
- Design reviews and functional testing before operations
- Work planning

POTENTIAL ENERGY HAZARDS

Possible Consequences:

- Physical injury (e.g., eye injury, broken bones, hearing loss, etc.)

Potential Initiators:

- Release of stored energy associated with compressed gases
- Puncture of a vacuum window
- Improper hoisting operation

Hazard Mitigation:

- All equipment is designed to applicable codes and standards
- Operation and design are reviewed by safety committees
- Functional testing before operations
- Training and adherence to procedures by operators of compressed gas systems

- Only trained personnel are allowed to perform hoisting operations
- Written procedures or supervisory participation in large equipment moves
- Work planning

Training Requirements

IONIZING RADIATION HAZARDS

- Radiological Worker I (HP-RWT002)
- Contamination/Airborne course and practical (HP-RWT-300/A)
- GE-64 - Contamination/Airborne Qualified
- Collider-Accelerator Access (AD-CA_ACCESS)

HAZARDOUS OR TOXIC MATERIAL HAZARDS

- Hazard Communication Training (HP-OSH-200)
- Lead in the Workplace (TQ-LEAD1)

FLAMMABLE OR COMBUSTIBLE MATERIAL HAZARDS

- Fire Watch (HP-FRF-202)
- Emergency Planning and Response (GE-EMERGPLAN) (Initial Train)

ELECTRICAL ENERGY HAZARD

- Electrical Safety I (TQ-ELECSAF1)
- Lock Out/Tag Out Authorized Employee Training(HP-OSH-151B-W)
- Electrical Safety Work Practices (AD-ELECSAFETY)
- Department Specific Lockout Tagout (AD-LOTO-OJT)

MAGNETIC FIELD AND ELECTROMAGNETIC RADIATION HAZARDS

- Static Magnetic Fields (TQ-SMF)

THERMAL ENERGY HAZARDS

- General Employee Training (HP-V-001) (Initial Train)

CRYOGENIC TEMPERATURE HAZARDS

- Cryogen Safety (HP-OSH-025)

KINETIC ENERGY HAZARDS

- Noise and Hearing Conservation (TQ-NOISE)
- Crane Safety (HP-Q-010)
- Crane Operator Practical (HP-Q-010)

POTENTIAL ENERGY

- Lock Out/Tag Out Affected Employee Training (HP-OSH-151A-W)
- Lock Out/Tag Out Authorized Employee Training(HP-OSH-151B-W)
- GE-81 - Fall Protection-Qualified
- Stop Work Procedure Training (GE-STOPWORK)
- Crane Safety (HP-Q-010)
- Crane Operator Practical (HP-Q-010)

Regulatory Determination of Process
(Identify Applicable OPMs; See OPM 1.10.4.a, Flow Down Matrix for Higher Level Documents)

IONIZING RADIATION HAZARDS

- 9.5.1 C-A ALARA Policy and Responsibilities

HAZARDOUS OR TOXIC MATERIAL HAZARDS

- 1.8 Hazard Communication Procedure

FLAMMABLE OR COMBUSTIBLE MATERIAL HAZARDS

- 1.9 Fire Safety Program

ELECTRICAL ENERGY HAZARD

- 1.5 Electrical Safety Implementation Plan
- 9.3.4 Review and Approval of Electrical Equipment Built In-House

OXYGEN DEPLETION HAZARDS (Does not apply to shop areas at this time)

- 3.15 Response to Low Oxygen Alarm in ODH Class 0 and 1 Areas
- 4.44 Operation of PASS
- 12.11 Oxygen Deficiency Hazard Response (Tandem)

MAGNETIC FIELD AND ELECTROMAGNETIC RADIATION HAZARDS

- 9.2.1.d Threshold Limit Values For Magnetic Fields

THERMAL ENERGY HAZARDS

- 9.3.1 Procedure for Reviewing Conventional Safety Aspects of a C-A System

CRYOGENIC TEMPERATURE HAZARDS

- 7.1.39 Cryogenic Group Lockout/Tagout
- 9.6.1 Cryogenic System Review

KINETIC ENERGY HAZARDS

- 1.17 C-A Hearing Conservation Program
- 8.25 Material Handling and Lifting Safely: Equipment and Procedures

POTENTIAL ENERGY

- 1.6 Mechanical System(s) Safety Implementation

Assessment from Workers Health Surveillance
(Review Injury Statistics for Area From SHSD Spread Sheet And Injury Report)

Hazard Description	1 Injury/Illness Description	3 Number of Injuries/Illness 2000-2002	4 Number of Critiques for year 2000-2002	5 Number of Occurrences for year 2000-2002	6 Injury Sum add columns 3,4 and 5
Ionizing Radiation Hazards		0	1	0	1
Hazardous Or Toxic Material Hazards		0	2	0	2
Flammable Or Combustible Material Hazards		0	0	0	0
Electrical Energy Hazard		0	1	0	1
Oxygen Depletion Hazards		0	0	0	0
Magnetic Field And Electromagnetic Radiation Hazards		0	0	0	0
Thermal Energy Hazards		0	0	0	0
Cryogenic Temperature Hazards		0	0	0	0
Kinetic Energy Hazards	Hand Laceration Groin Strain Back Strain Finger Laceration	1 1 1 1	0	0	4
Potential Energy		0	0	0	0

Risk Assessment
(Using Risk Matrix, Table 1)

Hazard ID	Risk Level Scale
Ionizing Radiation Hazards	**1**
Hazardous Or Toxic Material Hazards	**1**
Flammable Or Combustible Material Hazards	**2**
Electrical Energy Hazard	**2**
Oxygen Depletion Hazards	**1**
Magnetic Field And Electromagnetic Radiation Hazards	**1**
Thermal Energy Hazards	**1**
Cryogenic Temperature Hazards	**2**
Kinetic Energy Hazards	**1**
Potential Energy	**2**

Risk Metrics

List hazards; rank them using Tables 1 and 2; multiply the scores to get a Relative Risk Level.

Hazard ID	1	2	3	4	
	Scope Scale	Risk Level Scale	Compliance Scale	Injury Sum	Relative Risk Level, product of columns (0=1) 1-4
Ionizing Radiation Hazards	2	1	3	1	6
Hazardous Or Toxic Material Hazards	2	1	3	2	12
Flammable Or Combustible Material Hazards	2	2	2	0	8
Electrical Energy Hazard	2	2	2	1	8
Oxygen Depletion Hazards	1	1	1	0	1
Magnetic Field And Electromagnetic Radiation Hazards	2	1	1	0	2
Thermal Energy Hazards	2	1	1	0	2
Cryogenic Temperature Hazards	2	2	1	0	4
Kinetic Energy Hazards	2	1	1	4	8
Potential Energy	2	2	2	0	8

Hazard Minimization Opportunities for Accident Prevention

(Select the four highest Overall Risk Levels from Section 8)

1. Hazardous or Toxic Material Hazards
2. Electrical Energy Hazard
3. Kinetic Energy Hazards
4. Flammable or Combustible Hazards

On October 2, 2002 Derek Lowenstein, C-A Department Chair, charged an ad hoc Electrical Safety Review Committee to review non-compliances reported in external and internal assessments. The Committee determined that LOTO logbooks are not always used to record LOTO and that it was a time-consuming task to associate a given LOTO tag with a particular logbook entry at C-AD. The Committee determined that alternate web-based LOTO systems appear to be potentially useful for tracking individual LOTOs, for tracking LOTO evolutions, and for issuing LOTO tags. The ad hoc Committee also determined that used LOTO tags and stubs should be destroyed after use; again to avoid the appearance of non-compliance.

The Committee also determined that up to date one-line drawings are needed in order to ensure that the correct protective equipment is chosen when working hot. The Committee clarified that verifying a LOTO is working hot if the testing equipment is manipulated by hand. The committee determined that the Department lacks a written grounding plan for accelerators and beam lines. These issues and other issues associated with training were addressed in the ad hoc Committee's recommendations, and are identified as an opportunity for an injury reduction initiative.

Employee awareness of safety was increased through participation in Laboratory Safety Day. Participation is planned to continue if Laboratory Safety Day is adopted as an annual event at BNL. A review of safety behavior at Collider-Accelerator was performed by consultants from Dupont in January 2003. Their recommendations are being reviewed by a Laboratory Safety Improvement Team, and C-AD has representation on the team.

At the Department level, hazardous and toxic materials hazards, kinetic energy hazards and flammable/combustible hazards are being addressed by implementing an OSH management system similar to OSHAS 18001 and ILO-OSH-2001. Several features of the OSH management system include:

- Creation of a Worker Occupational Safety and Health Committee
- An annual Management Review similar to ISO 14001
- Annual audit by the QA Group against OSH requirements in SBMS and requirements set down in Department level OSH management documents

Injury/Illness Reduction Initiatives

Hazard ID	New OPM, Inspection Process, or Other Mechanism	ATS , ADS Number or Reference
Electrical Energy Hazards	Review electrical safety issues at C-A through an Ad Hoc Electrical Safety Review Committee. Review and implement appropriate corrective actions recommended by Office of Independent Oversight during an Electrical Safety Review at C-AD. Implement corrective action recommended by the Ad Hoc Committee; for example, implement a Web Based LOTO data entry/Tag system.	ATS-1425 ATS-1425.2 ATS-1425.1.8
Hazardous Toxic Material Hazards	Perform annual management review of hazardous toxic material hazards. Implement corrective action recommended by management review process.	ESHQ Tickler Card (TC-5)
Kinetic Energy Hazards	Increase employee awareness of safety through participation in Laboratory Safety Day. Perform a management review of OSH. Increase safety and heath awareness and participation of all C-A staff through implementation of the C-A OSH Management System	OPM 1.10.4 OPM 1.10.4 OSH Team Task List
Flammable and Combustible Hazards	Update of C-AD Accelerator Safety Envelopes for managing response to fire alarms. Perform and review emergency response drills at C-A. Replace various Fire Alarm Panels in building 930.	OPM 2.5 ATS-1382 ADS-AA2D0076

The Risk Matrix (Table 1)

Consequence Level

High	Low Risk – Acceptable *(Risk level 2)*	Medium Risk- Unacceptable *(Risk level 3)*	High Risk- Unacceptable *(Risk level 4)*	High Risk- Unacceptable *(Risk level 4)*
Medium	Extremely Low Risk - Desirable *(Risk level 1)*	Low Risk – Acceptable *(Risk level 2)*	Medium Risk- Unacceptable *(Risk level 3)*	High Risk- Unacceptable *(Risk level 4)*
Low	Extremely Low Risk - Desirable *(Risk level 1)*	Extremely Low Risk - Desirable *(Risk level 1)*	Low Risk – Acceptable *(Risk level 2)*	Medium Risk- Unacceptable *(Risk level 3)*
Extremely Low	Extremely Low Risk - Desirable *(Risk level 1)*	Extremely Low Risk - Desirable *(Risk level 1)*	Extremely Low - Desirable *(Risk level 1)*	Low Risk – Acceptable *(Risk level 2)*
	Extremely Unlikely ($<10^{-4}$/y)	**Unlikely (Between 10^{-4}/y and 10^{-2}/y)**	**Anticipated(Note) Medium (Between 10^{-2}/y and 10^{-1}y)**	**Anticipated (Note) High (Above 10^{-1}y)**

Likelihood of Occurrence →

Definition of Consequence Levels

- Extremely Low: Will not result in a significant injury or occupation illness or provide a significant impact on the environment.

- Low: Minor onsite with negligible or no offsite impact. Low risk events are events that may cause minor injury or minor occupational illness or minor impact on the environment.

- Medium: Medium risk events are events that may cause considerable impact onsite or minor impact offsite. Medium risk events may cause deaths, severe injuries or severe occupational illness to personnel or major damage to a facility or minor impact on the environment. Medium risk events are events from which one is capable of returning to operation.

- High: High-risk events may cause serious impact onsite or offsite. High-risk events may cause deaths or loss of facility/operation. High-risk events may cause significant impact on the environment.

Note: 10CFR835 may require limits that are more stringent for anticipated events.

Risk Metrics (Table 2)

List hazard, rank them using the scale below, four being the <u>most</u> significant.

Scale	Scope of Hazard Impact Scale	Outcome of Compliance Failure Scale
1	Unnoticeable (Low)	Minimal
2	Only one work area (Low)	Record keeping, warning only
3	Organization wide (Moderate)	Department Penalty
4	Impact Outside of the organization (High)	Civil /Criminal Penalty, fine