DRAFT
Experiment Safety Assessment Document for E-01-006

NOVEMBER 12, 2001

Contents

1 Introduction and Scope

Jefferson Lab has mounted an experimental proposal (E-01-006) to measure the nucleon spin structure in the region of the nucleon resonances. The experiment requires equipment not part of the set of standard equipment in Hall C. These are a polarized target and a chicane of two electromagnets.

This document deals with each of these two systems separately and evaluates the hazards associated with each system. It further identifies what measures have been implemented in order to mitigate the hazards that have been identified.

2 Polarized Target

Polarized targets have been used in nuclear and high energy scattering experiments for many years. The ability to align the spin of nuclei has been developed for experimental studies of the spin properties of matter. A variety of techniques have been developed, and polarized target technology continues to be an active field of research, with technical improvements occurring which allow for better and different experimental measurements.

Until the first run of E93-026 (Neutron electric from factor) in 1998, JLAB had not operated a polarized target in Hall C. Experiments with polarized targets at other labs, such as CERN, Brookhaven, Fermi Lab, and many Nuclear Physics facilities are common. This polarized target project follows a well-established practice in experimental particle physics. The UVa group, who along with the Target Group at Jefferson Lab is responsible for the polarizerd target to be used in this experiment, has successfully and safely completed three experiments (E143, E155 and E155x) using this polarized target at SLAC.

2.1 Target Components

The target at Jefferson Lab consists of several technical components:

- a superconducting solenoid operating at 5 Tesla at 4 K and power supply
- a helium refrigerator operating at 1 K
- an RF System to provide 140 GHz microwaves to dynamically polarize the material
- several small containers of solid ammonia (NH_3 and ND_3), the material which is polarized
- a vacuum pump and piping system to reduce the pressure in the refrigerator which cools by evaporation of helium
- a vacuum chamber to hold the refrigeration system, target material and the solenoid plus its cryostat.

In addition to the target, equipment to operate and maintain the target are installed in Hall C. These items consists of:

- electrical and mechanical utilities
- cryogenic utilities
- control panels and cables to permit operation of the target from the outside of Hall C
- monitoring equipment to allow measurement of target polarization
- beam pipe, beam transport and beam-safety equipment related to the target.

2.2 Target Location

The polarized target is located entirely within the Jefferson Lab Hall C building. It is located on the beam line which passes through the building, approximately in the center of the floor. Control cables and cryogenic plumbing have been extended to the outside of the wall, so that operation of the target can be accomplished while beam is passing through the Hall. Liquid nitrogen and helium are available for the cryogenic cooling.

The polarized target is located on the pivot in Hall C. For the purpose of this document, the target "lower platform" is taken to be the area above the pivot and below the target "upper platform". See Figure 1. This is the area where the thin vacuum windows in the dewar outer vacuum vessel are located. The HMS deck refers to the portion of the HMS located just beyond the pivot from which access to the pivot may be gained.

There is an additional platform, known simply as the "target platform" that did not exist in the 1998 run. It is shown in Fig. 2. The magnet buffer dewar, magnet power supply, two electronics racks and a computer are situated on this platform.

2.2.1 Hazards

The target lower platform is more than 10 feet above the floor of the end station. If a person were to fall from the target lower platform to the floor of the endstation a serious or even a fatal injury could result.

2.2.2 Hazard Mitigation

Access to the target lower platform requires that the removable handrails are in place or that the worker use the fall protection harnesses that are available in the hall. Signs are posted at the access points to the lower platform stating these requirements.

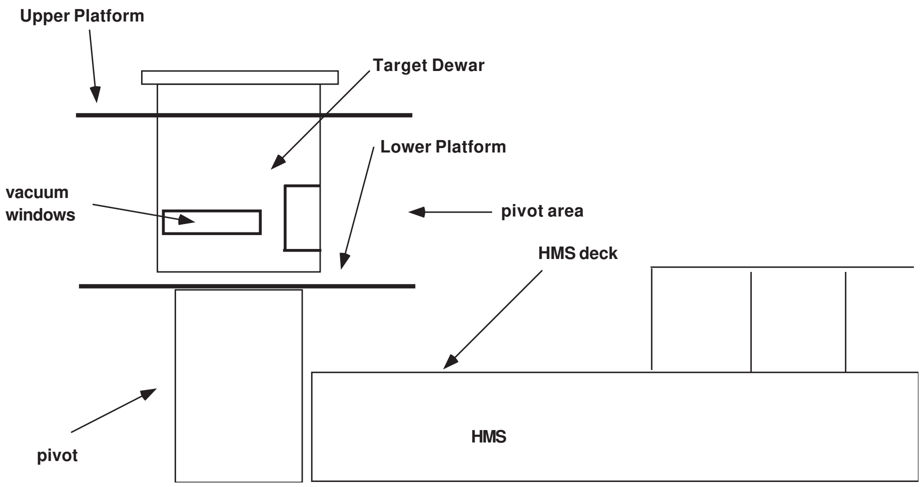

Figure 1: Layout of Polarized target in Hall C

2.3 Outer Vacuum Chamber

The outer vacuum can, OVC, for the polarized target is an aluminum vessel which was manufactured for JLAB by the University of Maryland. The can has a diameter of 37.625 inches (95.57 cm).

The can has a number of thin vacuum windows to allow for the detection of particles as well as passage of the primary electron beam. Two of these windows span 102 degrees and have a height of 4.5 inches. We refer to these large cutouts in the scattering chamber as "smiles". These windows are covered by 0.008 inch thick 5052 H39 Aluminum. These windows are comparable to the windows on the standard Hall C scattering chamber which were constructed of the same material. The windows were tested on the scattering chamber by pressurizing with air from the outside until failure. The windows failed at 40 PSIG which is a margin of 2.7 times atmospheric load.

There is one more large area window. This window spans 36 degrees and has a height of 10.5 inches. This window is covered with 0.016 inch thick 5052 H34 Al. It was tested to failure by pressurizing with air from the outside. In testing the window failed at over 40 PSIG and hence has at least a safety margin of 2.7.

A small 3 inches diameter window is located diametrically opposite the third large window. This window is covered with 0.015 inch thick beryllium plate, mounted on a 6 inches diameter Conflat flange. It has been tested by the manufacturer, Brush-Wellman, to [1.2] atmospheres, with a [1.2] safety margin.

2.3.1 Hazards

There exists an implosion hazard at the scattering chamber. If the scattering chamber windows were to be ruptured the pressure differential may cause an implosion. It is possible that those near the scattering chamber when an implosion occurs may suffer hearing damage.

2.3.2 Hazard Mitigation

All personnel working on the lower platform deck must have hearing protection. Signage is posted stating this requirement.

To prevent accidental rupture of the vacuum windows plastic ($\frac{1}{4}''$ polycarbonate) or $\frac{1}{16}''$ aluminum protection shall be in place on all the windows when the target contains liquid He. The scattering chamber will be placed in two mutually perpendicular configurations: magnetic field axis parallel to the beam and magnetic field perpendicular to the beam. In the parallel configuration the beam enters and exits the target through the upstream and downstream "smiles". A variant of the parallel configuration will also use the smiles, with the field at 10 degrees to the left of the beam. In the perpendicular configuration, the beam enters the target through the small 3 inch upstream window and exits through the large 10.5 inch window. Hole cut–outs will accommodate the upstream and downstream beam pipes and the HMS for the windows in the beam path. Plastic ($\frac{1}{4}''$ polycarbonate) protection similarly shall be in place at all times over the windows not along the beam. The protection described above will leave small portions of the vacuum window exposed. An effort will be made to minimize this exposure by covering any oblique access with a durable material, *kevlar*.

2.4 Magnet Field

The 5 T magnetic field is produced by a set of precision superconducting, iron-free quasi-Helmholz coils which have substantial fringe fields. Further the vacuum chamber has thin windows that must be protected. The strong fringe field is capable of forcefully pulling objects to the magnet – the thin windows are thus doubly vulnerable.

2.4.1 Hazards

Certain precautions must be taken to ensure that hazards will not exist due to the effect of a magnetic field on magnetic materials or on surgical implants. Typical of such effects are the following:

- Large attractive forces may be exerted on equipment brought near to the magnet. The force may become large enough to move the equipment uncontrollably towards the magnet. Small pieces of equipment may therefore become projectiles, large equipment (e.g. gas bottles, power supplies) could cause bodies or limbs to become trapped between the equipment and the magnet. Either type of object may cause injury or death. The closer to the magnet, the larger the force. The larger the equipment mass, the larger the force.

- The operation of medical electronic implants, such as cardiac pacemakers, may be affected either by static or changing magnetic fields. Pacemakers may malfunction if exposed to fields above 5 gauss.
- Other medical implants, such as aneurysm clips, surgical clips or prostheses, may contain ferromagnetic materials and therefore would be subject to strong forces near to the magnet. This could result in injury or death. Additionally, in the vicinity of rapidly changing fields (e.g. pulsed gradient fields), eddy currents may be induced in the implant resulting in heat generation.
- The operation of equipment may be directly affected by the presence of large magnetic fields. Items such as watches, tape recorders and cameras may be magnetized and irreparably damaged if exposed to fields above 10 gauss. Information encoded magnetically on credit cards and magnetic tape including computer floppy discs, may be irreversibly corrupted. Electrical transformers may become magnetically saturated in fields above 50 gauss. The safety characteristics of equipment may also be affected.

2.4.2 Hazard Mitigation

To prevent the situations discussed above several actions have been taken. The magnet site has been reviewed and equipment that would be adversely effected by the high field has been removed.

Before the magnet is energized a sweep of the immediate area is required. The purpose of this sweep is to eliminate any loose metal objects that might be moved by the magnetic field.

The area around the magnet has been posted with signs that indicate the presence of the field and warn wearers of medical implants of the potential hazard.

3 Analysis of Special Hazard

In a previous accident, the sudden, catastrophic loss of insulating vacuum in the Hall C polarized target resulted in rupture of the magnet helium dewar. As a result, super-insulation was dispersed over distances of tens of feet, though no structural damage to the liquid nitrogen shield or the outer vacuum vessel occurred and no heavy projectiles were created. Also, the individual in the pivot area at the time did not suffer any injuries. The accident occurred after approximately three months of polarized target operation.

Loss of the insulating vacuum can occur rapidly if one of the thin vacuum windows is pierced. These vacuum windows are particularly vulnerable when the magnet is energized because the field of the target magnet is strong enough to pull relatively heavy metal objects (wrenches, survey tripods, etc.) from the hands of a person standing four or five feet away and project such objects through the windows – the thin windows are thus doubly vulnerable.

The following details the design changes intended to minimize the consequences of a sudden loss of insulating vacuum (IV) and other hazard mitigating measures and procedures.

3.1 Modifications to the magnet dewar

An analysis[1] of the pressure relief path for magnet dewar indicated that modifications to the existing risers and relief piping would significantly decrease the differential pressure across the dewar in the event of a combined IV loss and magnet quench. The calculations indicate that, with these modifications, a combined IV loss and magnet quench would not result in the rupture of the magnet can. These modifications have been made to the magnet dewar. The laboratory now considers the hazards associated with the operation of the magnet dewar to be significantly mitigated. These modifications **do not in any way** obviate the measures described below.

3.2 Hazard Mitigation

This section specifically takes into consideration the lessons learned from the accident of October 7, 1998, and describes the implemented controls. The mitigating measures fall roughly into two categories, which are not mutually exclusive: engineering measures (such as window covers, warning devices and physical security), and administrative measures (such as training, signs and operating procedures). The engineering measures are discussed in sub-sections below. The administrative measures are discussed separately, in Section 3.2.2.

3.2.1 Engineering Measures

Before the magnet can be energized, the following must be in place,

1. Plastic ($\frac{1}{4}''$ polycarbonate) or $\frac{1}{16}''$ aluminum protection shall be in place on all the windows when the target contains liquid He. The scattering chamber will be placed in two mutually perpendicular configurations: magnetic field axis parallel to the beam and magnetic field perpendicular to the beam. Hole cut–outs will accommodate the upstream and downstream beam pipes and the HMS for the windows in the beam path. Plastic ($\frac{1}{4}''$ polycarbonate) protection similarly shall be in place at all times over the windows not along the beam.

   Polycarbonate shields may become become activated and may be a source of radioactive contamination. Notify RadCon before handling these shields.

[1]Memo by Mike Seely to Dennis Skopik, December 6, 2000.

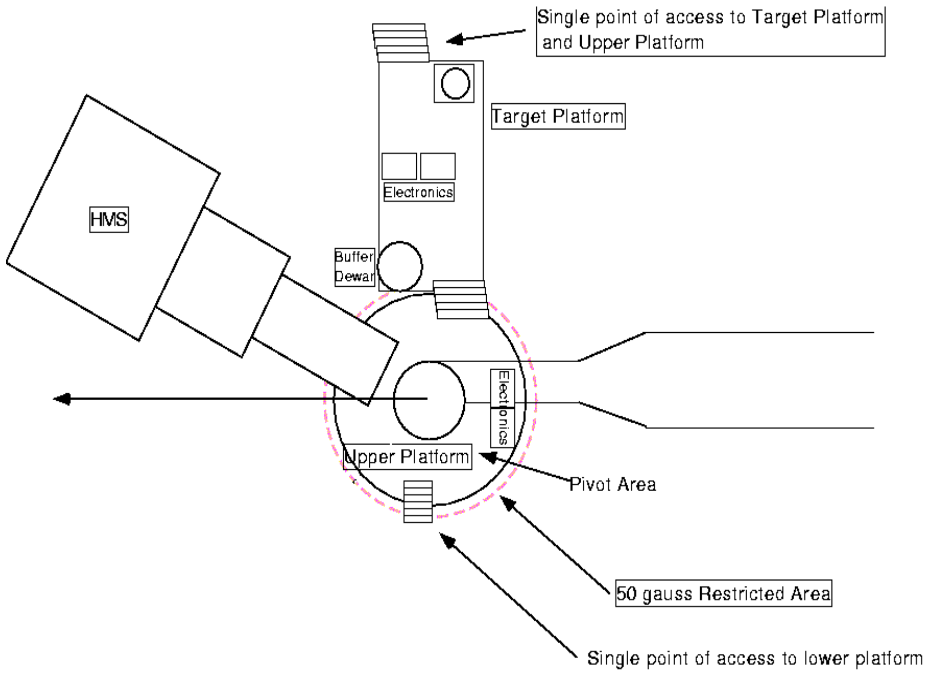

Figure 2: Approximate Restricted Area around Hall C pivot

2. To ensure that entry to the hazard areas is limited, both the upper and lower platforms will have single points of access. Access routes to upper platform are constrained to be only the stairs from the instrumentation platform. There will be a chain across the stairs that must be in place anytime the upper platform is not occupied. Signage will be hung from the chain. There will be no access to the upper platform from the SOS, and access to the lower platform will be restricted to occur only from the upper platfrom, where a ladder will be permanently placed. The gate leading to this ladder from the upper platform will remain locked. Four keys to open the lock have been assigned to the Hall C Safety Warden, the JLab Polarized Target Group leader, the Hall C Work Coordinator and the Shift Leader, respectively. Red warning lights indicating the presence of a magnetic field will be clearly visible from all access points to the upper and lower platforms (See Figure 2).

3. The 50 gauss contour must be delimited by a sturdy, construction–type plastic fence or barrier tape. The area delimited must include the floor of the hall all around the pivot. The upper platform, while within the 50 gauss contour of the target magnet, is not delimited by a barrier. Access to the “upper platform” and the “target platform” is allowed during Controlled Access.

4. Signs restricting access to the interior of the 50 gauss contour must be posted and they must include the following wording:

   Special Hazard
   For Access Contact Run Coordinator at 876-1791

   These signs must be posted at 10 foot intervals along the perimeter of the 50 gauss contour.

5. On the outer gate to Hall C a sign will be posted which reads

   During Controlled Access
   Contact Run Coordinator
   Phone 876-1791

3.2.2 Hall Access Control

The reader should first refer to Section B.1 of the COO with regard to the badge reader system in Hall C.

Ensuring that everyone who enters the hall is aware of the conditions and that those conditions are suitable for the needs of those entering is crucial. There are special added restrictions for work on the lower platform which apply regardless of the hall status.

Lower Platform Access

- All work on the lower platform is excluded while the magnet is on.
- When the magnet is not energized, only work approved by the Run Coordinator, after consultation with the Hall C Work Coordinator, may proceed on the lower platform. In addition to approval, the following conditions must be met before work on the lower platform takes place: all vacuum window shields must be in place; the chicane magnets, BE, BZ1 must be de-energized; hearing and fall protection guidelines must be followed; and a radiation survey must be performed after the target magnet is de-energized.
- The gate leading to the lower platform can be unlocked only by the designated key holders (Safety Warden, Work Coordinator, Polarized Target Group leader) or by a worker who meets the requirements to work on the lower platform and is authorized by the Shift Leader.

During normal running of the experiment (non-maintenance days), entries to the hall will normally be made while the hall status is Controlled Access. Maintenance days are ideal opportunities for target calibration studies, hence a Target Operator will be on shift.

Badge Reader Access Control

Access will be allowed for those individuals whose name appear on the "Approved Access List" (See Section B.1 of the Hall C COO). This is a list maintained by the Hall C Leader in communication with the Spokespeople and their surrogate, the Run Coordinator. Persons on the list are deemed by the above to be fully cognizant of all safety hazards associated with their work in the hall.

The "core" list will contain the names of individuals who have read this document and the COO, and have stated so in writing plus the Hall C scientific and technical staff. In addition, the MCC ARM's and members of the RadCon group will receive an abbreviated hazard awareness document. Additions, perhaps temporary, will be made as needed after ensuring that the individuals have received adequate hazard awareness training. An escort may be required.

Persons wishing to be added to the list must contact the Run Coordinator who will request that the Hall C Leader add the qualified individual to the "Approved Access List".

- Persons on the core list may go to the hall to perform routine work anywhere that other restrictions do not apply. Examples of areas with additional restrictions are posted radiological hazards and the lower platform.

- Only individuals who are trained Target Operators or ARM's shall go to the upper platform. Other experimenters shall be accompanied by a Target Operator.

- Outside Workers must first contact the Hall C Work Coordinator who in turn will contact the Run Coordinator. Then, with the concurrence of the Run Coordinator, the Hall C Work Coordinator, will provide authorization for hall access. All outside workers must check in at the Hall C counting house immediately before entering the hall. If the Run Coordinator or Hall C Work Coordinator feels it necessary, he/she will appoint a knowledgeable individual to escort the Outside Worker into the hall.

  In summary, **the Hall C Work Coordinator with concurrence with the Run Coordinator, must approve authorization for access for Outside Workers who want access to Hall C.**

- The Run Coordinator has the right to deny non-emergency access until the polarized target is in a condition that allows the proposed work to proceed safely.

Transition to *Restricted Access*

E-01-006 will operate under a restrictive process for changing the status of the hall from Controlled to Restricted Access. It is inevitable that some activities or the condition of the accelerator will require that the state of the hall be changed to Restricted Access. Even in Restricted Access, work on the lower platform is still regulated by signs on the 50 Gauss barrier that indicate the necessity to contact the Run Coordinator for entry. If deemed necessary, the Hall Work Coordinator may designate a Hall C technical staff person to remain in the hall while the work is ongoing.

Rules govern the transition to Restricted Access. These rules, enumerated below, will be posted in the Hall C counting house and a written checklist will be provided for use by the Run Coordinator. These requirements do not apply in the caseof an emergency.

- The transition from Controlled to Restricted Access can only occur after approval is received by accelerator operations from the experiment Shift Leader. If no shift is underway the experiment Run Coordinator may designate himself/herself as the acting Shift Leader.

  The laboratory recognizes only the experiment Shift Leader as the individual authorized to request a change in condition of the Hall. This individual must be on site and have the verbal concurrence of either the Hall C Work Coordinator or Physics Liaison prior to issuing his/her request to the MCC. The Boolean logic for this condition is given below:

  ACCESS = Shift Leader* .AND. (Physics Liaison .OR. Work Coordinator) = .TRUE.

  The experiment has additional requirements internal to the collaboration which need to be satisfied prior to the Shift Leader issuing his/her request to the MCC. This includes a verbal approval by the experiment Run Coordinator. The Boolean logic for this condition is given below:

  Shift Leader* = Shift Leader .AND. Run Coordinator = .TRUE.

- In addition the Run Coordinator must arrange that the target field is de-energized and arrange that the magnet leads are removed from the supply. The Target Expert will disconnect the magnet leads at the magnet supply and lock the leads in a manner compliant with Jefferson Lab's lock and tag policy. The Hall C Work Coordinator (or deputy) will verify that the leads are locked away.

- The Run Coordinator must arrange that all vacuum window shields are in place (Typically, no windows should need installation. However their integrity should be affirmed.). The Hall C Work Coordinator or his/her designee is charged with the inspection of the window coverings. If this requires access to the lower platform, this individual shall wear hearing protection and a face shield while performing this operation.

- The Run Coordinator must arrange for the Hall C Work Coordinator, Safety Warden or his designee to supervise the activity that necessitated the change. The state of the hall should revert to Controlled Access or Badge Reader control with Mag Locks Energized when work allows or at the end of the working day.

The time order is: Via the process above the Shift leader determines that the hall state must change to Restricted Access. The Run Coordinator or the Shift Leader requests that the Target Coordinator or his designee ramp the target field down. Once the field is down, the Hall C Work Coordinator (or his designee) and an ARM can enter and visually inspect the window coverings. Then, a complete radiological survey can take place. The Target Expert will disconnect the magnet leads at the magnet supply and lock the leads in a manner compliant with Jefferson Lab's lock and tag policy. The Hall C Work Coordinator (or deputy) will verify that the leads are locked away. The Shift Leader communicates this request to MCC and the state of the hall can be altered. Finally, the Hall C Work Coordinator (or his designee) must supervise the activity that necessitated the change. If deemed necessary, the Hall Work Coordinator may designate a Hall C technical staff person to remain in the hall while the work is ongoing.

3.3 Magnet Power Supply

The power supply for the superconducting magnet is a low voltage device. It has a driving voltage of less than 10V and provides a maximum of 120 amps. During normal operation it poses no special hazards. However during a quench of the magnet high voltages may be produced at the leads to the magnet. An insulating cover shall be placed over the connection of the current leads to the magnet.

3.4 Fire and Explosion Hazards

Water must not be used on electrical equipment and when sprayed on cryogenic liquids will rapidly freeze. The magnet ventilation may become blocked by ice with subsequent risk of explosion and the release of cryogens from the system. The surface temperature of containers for liquid nitrogen and helium, if not vacuum insulated, may be sufficiently low to condense oxygen or oxygen enriched air. This liquid in contact with flammable substances can become explosive. Local emergency services must be informed of the presence of a magnet operating in their area as this may affect their procedures in dealing with fires or other accidents.

3.5 Microwave Source and Power Supply

3.5.1 Hazards

Serious hazards exist in the operation of microwave tubes

1. High Voltage – Most microwave sources operate at voltages high enough to kill through electrical shock.

2. RF radiation – Exposure to RF radiation can cause serious bodily injury resulting in blindness or death. Cardiac pacemakers may be affected.

3. Hot coolant and/or steam - For liquid cooled collectors, the electron collector and water used to cool it reach scalding temperatures. Touching or rupture of the cooling system can cause serious burns.

3.5.2 Hazard Mitigation

1. High Voltage – The high voltage supply circuit has a protective interlock system which prevents accidental contact with high voltage. The interface box between the EIO and the power supply is sealed and has an interlock system such that if opened the high voltage is tripped off.

2. RF radiation – The "extended interaction oscillator", – the EIO tube, has a nominal operating point at 140 GHz. This frequency range is far beyond the current region of microwave hazards defined by existing standards. In this frequency range local heating effects are assumed to be the only hazard encountered.

   We have attempted to quantify possible leakage of microwave power from the waveguide system in order to minimize loss from the guides as well as to prevent burn injuries. We have been unsuccessful inasmuch as the frequency response of the equipment available to us was incapable of detecting any radiation in the frequency band of interest.

3. Hot coolant – This EIO operates at a temperature less than $40^\circ C$ and there is a hardware interlock which trips off the power supply if the temperature exceeds $40^\circ C$.

3.6 Additional Documents

Additional documents (for experimenters) associated with the Polarized Target are

1. The Polarized Target Operation,

2. The Polarized Target Microwave Power Supply Operation,

3. The Polarized Target Anneal of Ammonia Target Material.

These documents can be found in the Hall C Counting House and constitute the *Polarized Target Handbook 2002.*

4 Chicane

In order to accommodate the deflection caused by the large 5.1 Tesla holding field of the polarized target's Helmholtz coils magnet, additional magnets have been added to the Hall C beam line. These magnets, together with the target magnet, comprise a vertical chicane.

The magnets are standard accelerator dipoles. The first is a BE mounted at the end of the tunnel alcove. The second magnet, designated BZ1, precedes the taget in the beam line. BZ1 is mounted on a large jack stand that allows for its vertical position to be adjusted. The jack is motor powered and the controls are locked out during normal operations to prevent accidental damage to vacuum components. Adjustments are done at the request of the Run Coordinator by the accelerator survey group, in conjunction with accelerator division mechanical technicians.

The upstream (w.r.t the scattering chamber) beam line exit window is purchased commercially from Brush-Wellman. The upstream exit window is a 0.015 inch thick, 2 inch diameter Be plate mounted in a 4.5 inch diameter stainless steel CF flange.

To reduce background from bremsstrahlung in the target, the downstream line is a metallic beam pipe followed by a large helium bag.The pipe is at the same pressure as the bag.

4.1 Hazards and Hazard Mitigation

The dipoles are powered by three DANFYSIK supplies which are located behind the green shield wall near the SOS supplies. These power supplies are high current devices and are thus potentially lethal. The supply properties are summarized below.

Magnet Name	I_{max} (Amps)	V (Volts)
BE	160	30
BZ1	240	40

The lead connections to all magnets have guards placed over them. In addition, there are red lights at the magnets which indicate that the supplies are DC enabled. MCC controls the magnets power supplies.

The supplies are not directly interlocked into the Fast Shutdown System (FSD). Protection against failure is provided by a number of measures. First, the total beam current into Hall C is limited by a BCM in the alcove (formerly BCM3). The limit is about 1.5 μA CW. Aside from this precaution, which basically limits the total power that can be sprayed about in the event of a magnet failure, Beam Loss Monitors (BLMs) and Ion Chambers have been placed near the pivot and these are tied to the FSD. As a final precaution, a Hall effect probe monitors the fringe field of the target magnet and the output of this probe is tied to the FSD.

The magnets in the chicane are cooled by the Low Conductivity Water (LCW) system. This is a high pressure system, $P = 250$ psi, and an unconfined stream of water at this pressure could cause injury. The LCW water system uses water hoses rated for 600 psi and they have been tested.

5 Personnel Allowed to Operate E-01-006 Equipment

This section will state all responsible personnel associated with each of the two subsystems, additional to the Hall C base equipment, used in the E-01-006 experiment. These two additional subsystems are the polarized target and the beam line chicane. The general procedure to add to this list of responsible personnel is by authorization of the person(s) in charge of a subsystem **and** the Hall C Leader.

5.1 Polarized Target

The Polarized Target consists of several technical components, a 5T superconducting solenoid, a 1K helium refrigerator, a 140 GHz RF system, vacuum chamber and associated pumps, and small containers of polarizable solid ammonia. The responsible personnel for this complex system are (between parentheses the pager numbers)

Donald Crabb x5555 [UVa]

Donal Day x5255 [UVa]

Chris Keith x5878 (584-5878) [JLab Polarized Target Group]

Paul McKee x5555 [UVa]

Dave Meekins x7440 (584-7440) [JLab Polarized Target Group]

Greg Smith x5505 (584-5505)) [JLab Staff Scientist]

Mikell Seely x5036 (584-5036) [JLab Polarized Target Group]

Hong Guo Zhu x5555 (584-5555) [UVa]

5.2 Beam Line Chicane

The beam line chicane for E-01-006 is a shared responsibility for the JLab Accelerator Division, who is in charge of setting up the beam line for beam transport, and JLab Physics Division Hall Staff, especially for the beam transport after the Polarized Target. Note that any configuration change can affect the site boundary dose and the production of airborne radioactivity, and as such is the responsibility of the JLab Radiation Control group. Any change in the beam line configuration will have to be discussed with responsible personnel of these three groups.

Hari Areti x7187 (584-7187) [Accelerator Liaison]

Mark Jones x7733 (584-7733) [Physics Division Liaison]

Bob May x7632 (584-7632) [Head JLab RadCon Group]

The Run Coordinator (cellular 876-1791) should be informed of any planned configuration change.

6 Educational Measures

This document contains all the information needed to operate the hall in a safe manner. The challenge is to disseminate the information contained in this document effectively to all the groups who are potentially affected by the rules of conduct delineated here and in the "Conduct of Operations". To this end the following steps will be taken.

- All Shift personnel are required to read this document and the COO and send verifying email to a Spokesperson. Individuals wishing to get on the "core Access Authorization List" must do this.
- A Collaboration meeting will be held at which the key points will be summarized.
- A talk will be given at MCC in which the key points are summarized.
- A special document, "E-01-006 *2002* Safety Guideline" will be prepared and distributed in which the key points are summarized. This will be used for hazard awareness training of key support personnel such as ARM's and members of RadCon.