Conduct of Operations for Hall C
Experiment E07-002 - January 7, 2008

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1 Preface

As part of its mission, JLab provides the resources necessary for international collaborations of scientists to carry out basic research in nuclear physics and related disciplines. This research must be conducted in a manner that ensures that environmental, health and safety (EH&S) concerns receive the highest consideration. At the same time the programmatic goals of the laboratory require that it produce the highest quality physics results efficiently.

Guidance on how to balance thoughtful, measured EH&S concerns with efficient operation has been taken from the JLab EH&S Committee, the JLab EH&S Manual, and the JLab Director's Office. A graded approach is followed in which the measures taken are matched to the scale, cost, complexity, and hazards of the operation.

This document outlines how approved experiment collaborations will conduct operations in a safe and effective manner during the time period that experiment E07-002 is on the floor. Installation and commissioning periods are not covered by this document. Furthermore, this document is directed to physics users and physics staff rather than the Hall C technical staff. It must be read, understood, and followed by all members of the collaboration.

2 Documentation

This experiment uses the standard Hall C equipment. All of the procedures to be used during the course of the experiment are contained in the following documents: [1]

- The Conduct of Operations for JLab Experiments (COO), the document you are now reading.
- Experiment Safety Assessment Document (ESAD) for E07-002 (referring to the base equipment as well as any experiment-specific changes)
- Radiation Safety Assessment Document (RSAD)
- Hall C Experimental Equipment Operations Manual (EEOM) [For Hall C, the safe equipment operations are listed in a more convenient manner at http://hallcweb.jlab.org/document/howtos/]
- Personnel Allowed to Operate Hall C Equipment
- JLab Emergency Response Plan

Reference copies of these documents will be available in the Counting House for the duration of the experiment. The present document shall hereafter be referred to as the COO. The Experiment Safety Assessment Document shall

[1] The process is documented at http: //www.jlab.org/user_resources/PFX/.

hereafter be referred to as the ESAD, and the Radiation Safety Assessment Document shall be referred to as the RSAD. The ESAD and COO may also be available on the WWW at an experiment-specific web site. **The COO, the ESAD and the RSAD are required reading for shift personnel.**

A full description of the physics motivation for the experiment, collaboration list, and the general plan for carrying out the experiment can be found in the proposal(s) to the JLab Program Advisory Committee (PAC).

3 Shift Personnel Training

All personnel on shift are required to have successfully completed and be current in the following JLab safety training:

- EH&S Orientation (SAF 100)
- Radiation Worker Training (SAF 801)
- Oxygen Deficiency Hazard Training (SAF 103)
- Hall C Safety Awareness Walk-Through (SAF111)
- Conduct of Operations (SAF122)

All experiment personnel are required to have radiation badges in their possession during their shifts. The Safety Awareness Walk-Through will emphasize any hazards that are peculiar to the current experimental setup. In addition, all shift personnel will be trained in the safety procedures to be followed for access to the Hall. This training will include a brief discussion of the purpose and operation of the Personnel Safety System (PSS) for the Hall. Individuals within the collaboration may be required to have other, equipment or procedure-specific training. The need for such training shall be determined by the experiment spokesperson in consultation with the Hall Leader and Physics Division EH&S personnel.

In addition, experiment personnel must familiarize themselves with the sections of the JLab EH&S Manual relevant for their work in the Hall. A reference copy of this document is available in the main hallway of the Counting House. It is also available via http://www.jlab.org/ehs/manual/EHSbook.html

Finally, JLab Lock and Tag[2] training is required for all staff/users who will be performing maintenance on electrical and mechanical equipment which cannot be physically and verifiably isolated from an energy source.

4 Organization and Administration

The operation of the experiment is directed by the Spokespersons and the Hall Leader, Steve Wood. An organization chart for the experiment is found in Figure 1.

[2]The EH&S Manual provides Lockout/Tagout information in Chapter 6110.

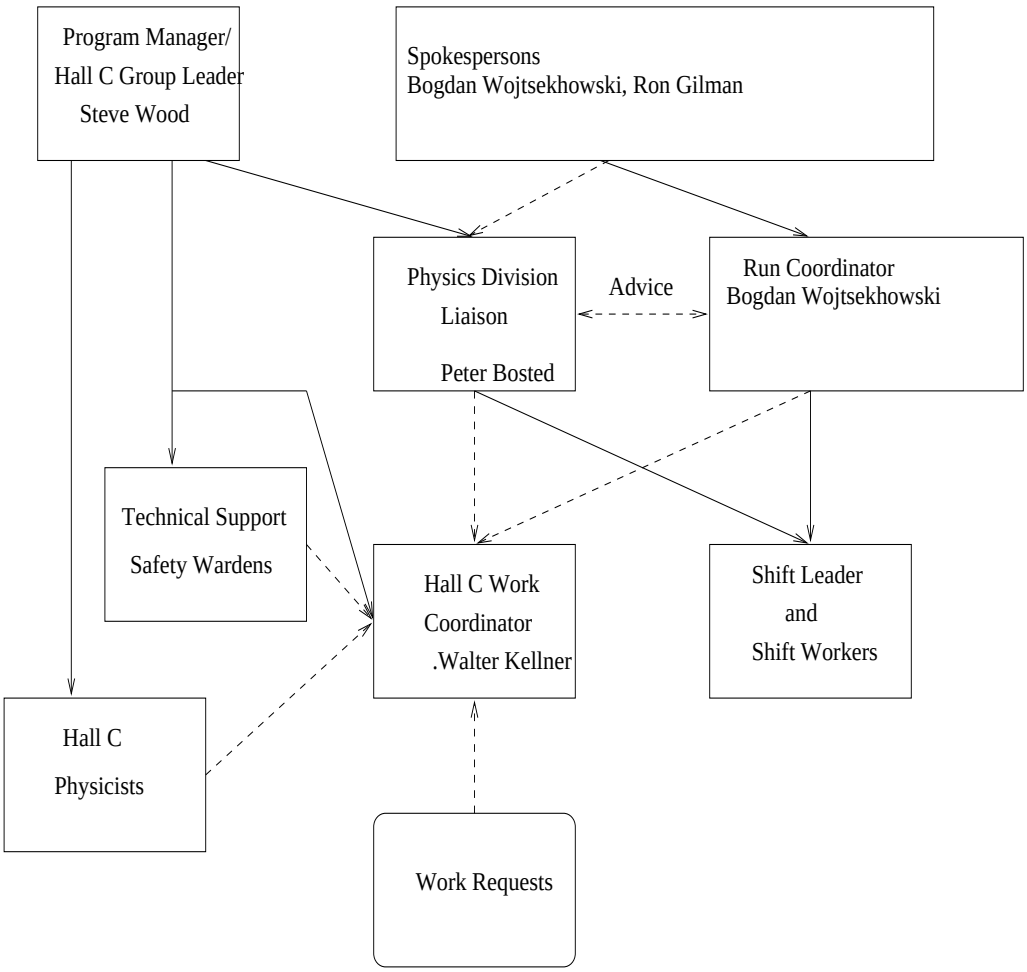

Figure 1: Functional Organization of the Hall C Team. Dashed lines indicate information flow, solid lines indicate responsibility.

4.1 Run Coordinator

The Run Coordinator is the immediate on-site manager of the experiment and is responsible for ensuring that the physics goals of the experiment are met. This individual is designated by the experiment spokespersons and approved by the Hall Leader. The Run Coordinator shall ensure that the Hall Group Leader, Physics Division Liaison, and at least one Spokesperson are aware of all pertinent issues. The Run Coordinator shall promote an environment in which the highest safety standards are maintained. The functions of the Run Coordinator are:

I. To manage daily operation of the experiment:

- to ensure that the run plan is clear to the shift workers.
- to define the data quality appropriate for the goals of each shift.
- to track the progress of the experiment.
- to coordinate and schedule activities (e.g., Hall accesses) in order to optimize productivity.
- to ensure that an experiment checklist is completed every 24 hrs during standby shifts.
- together with the Physics Division Liaison, to ensure that the counting house is manned appropriately: i.e., sufficient personnel are present to safely carry out the experimental program or monitor the apparatus as needed.

II. To coordinate interactions between Jlab and the experiment. This entails:

- informing the Program Deputy of the experiment's status and plans at a 7:45 AM meeting in the MCC during the working week, and at an agreed upon time on weekends or holidays.
- representing the collaboration at the 8:00 AM meetings in the MCC during the work week.
- attending the 1:30 PM Wednesday scheduling meeting in the MCC conference room to represent the collaboration and to present a report on the proceeding week.
- remaining in the local area and being available by cell-phone/pager at all times. (If temporarily unavailable the Run Coordinator must designate another qualified collaborator as a replacement.)
- in conjunction with the Hall Work Coordinator, scheduling work by groups outside the collaboration.

- interact with the Accelerator Program Deputy to plan and conduct unscheduled activities.

III. To submit a written report to the Hall Leader which includes run time statistics and a description of any significant problems with the Hall instrumentation.

4.2 Physics Division Liaison

Broadly speaking, the Physics Division Liaison to the experiment is a Hall C staff member selected by Steve Wood to oversee the hall's interests with respect to personnel and equipment protection.[3] This is true for all three halls. However, the role of the Physics Division Liaison may include other responsibilities depending upon the experiment and other factors. His/her responsibilities include:

- Oversee that proper rules of safety are carefully followed in the conduct of the experiment. This includes the period of decommissioning after the completion of the experiment.
- Approve a Hall status change to Restricted Access in coordination with the Hall Work Coordinator.
- Training verification of shift workers.
- Together with the Run Coordinator, ensure that the counting house is manned appropriately: i.e., sufficient personnel are present to safely carry out the experimental program or babysit the apparatus as needed.

4.3 Hall Work Coordinator

The Hall Work Coordinator's responsibilities are:

- to act as the **single point of contact for all work in the hall.**
- to determine if the scheduled activities in the hall can be done safely. These activities shall be coordinated with the Physics Division Liaison and the Run Coordinator.
- to ensure that workers are properly trained, are familiar with all significant hazards, and are aware of all applicable work control documents associated with the project.
- in coordination with the Physics Division Liaison, ensure that the hall apparatus is made safe before giving permission to make a transition to Restricted Access (e.g., turn off unused magnets, install protective shields as needed, fulfill specific requirements in the ESAD, etc.).

[3] The responsibilities described here correspond to those of the Physics Division Liaison during the operating phase of the experiment as outlined in the EH&S Manual Chapter 3120/Glossary.

4.4 Shift Leader

Each shift is led by a Shift Leader. The selection of shift leaders is the responsibility of the Run Coordinator and Physics Division Liaison. The Shift Leader has the following responsibilities:

- to carry out the scientific program planned for the shift in a safe and efficient manner.
- to ensure that the logbook contains a complete and accurate description of the events and actions which occurred during the shift.
- to serve as primary contact between the machine control center (MCC) and experiment personnel.
- to oversee that hall equipment is operated properly.
- to ensure the shift checklist is performed every eight hours on operating shifts.
- to ensure that equipment malfunctions are properly labeled and locked-out if necessary and to communicate this to shift personnel and subsystem experts.
- to note in the logbook when workers from outside groups (such as survey and alignment) stop by the counting house before entering the hall when in Controlled Access. Furthermore, to confirm that these workers have communicated with the Run Coordinator and the Hall Work Coordinator.
- to coordinate the response of the shift crew to any emergency situation, including the notification of appropriate individuals as outlined in the JLab Emergency Response Plan.
- to ensure that in any emergency situation the experiment Physics Division Liaison, Run Coordinator, and Hall Leader are notified immediately.
- to notify the Run Coordinator and the Hall Leader, if the hall is down due to equipment failure for more than four hours.

The Shift Leader has the following authority:

- to assign tasks to the shift members as needed.
- to request that the state of the hall be changed (Request for a change to Restricted Access must be approved by the Physics Division Liaison.)
- to limit the number of people in the Counting House or hall if required to effectively and safely carry out the experiment.
- to limit access to hall on-line computers if required to effectively and safely carry out the experiment.

- to authorize qualified personnel to make modifications in the experiment configuration within the allowed parameters, as specified in the EEOM.
- to authorize time accounting for the shift.

4.5 Shift Member

The responsibilities of each shift member are to:

- carry out the scientific goals of the shift in a safe and efficient manner under direction of the shift leader.
- read the logbook to be aware of changes in goals, operating parameters, and new documentation.
- monitor the equipment for problems.
- maintain adequate records of the progress of the shift.
- be present before the start of each shift and coordinate current operating conditions with the previous shift.
- keep all training up-to-date.

5 Operating Procedures

5.1 Shift Routines

There are two types of shifts for active hall experiments: Operating and Standby. Operating shifts are the normal status when beam is available for the experiment. Standby shifts are periods designated by the Run Coordinator when beam is not available or not in use in the hall and none of the equipment, except for the target, requires continuous monitoring. Standby status may result from normal operational planning or from abnormal conditions such as a major down time due to equipment failure.

5.1.1 Operating Shifts

During operating shifts, 24 hour occupation of the counting house area will be maintained by crews of at least two persons [4] in 8 hour shifts. One person per shift is designated as the Shift Leader.

The number of persons assigned to a shift will depend on the tasks assigned during the shift. A shift schedule will be posted in the Counting House listing the times and names of personnel on shift and identifying the Shift Leader and Run Coordinator. The shift schedule may be available at an experiment-specific website. The Run Coordinator may also designate and supervise other teams for duties such as offline analysis.

[4] The readiness review committee may require more personnel depending on the complexity of the experiment. Two people are the minimum required for safe operations.

5.1.2 Standby Shifts

During Standby shifts, shift personnel are not required to be on site at JLab but must be available through telephone contact to come in if they are needed. Monitoring the target system can require the presence of a Target Operator during a standby shift. The Target Operator then also acts as Shift Leader. The Run Coordinator will ensure that the shift checklist is executed at least once every 24 hours.

5.1.3 Operations Turnover

The electronic log book, accessible from the web, is a very effective means of remotely obtaining information about experimental operations. This allows experimenters to log in remotely and view all log book entries prior to commencing their shift. Information which can only be recorded in the paper log book, should be noted accordingly and communicated between incoming and outgoing shift personnel directly.

Efficient and effective shift changeovers during experiment operation are enhanced by overlapping shifts. Therefore, whenever possible, shift leaders and workers are scheduled in shifts that are staggered by four hours, leading to an overlap of half a shift.

5.1.4 Timely Orders to Operators

The initial run plan is the responsibility of the Run Coordinator and shall be clearly recorded in the log book. This plan specifies the tasks to be performed in the next 48 - 72 hours, including any special conditions or data runs, updated documentation and its location and/or alternate plans. Any changes to the run plan shall be recorded in the log book and the white board in the counting house.

5.1.5 Operator Aid Postings

The day-to-day schedule, contact instructions for key personnel, and any other information relevant to current activities are located on the white board in the Counting House. Shift personnel should consult the white board, especially at the beginning of their shift, to be aware of any updates to current running conditions.

Information pertaining to activities in Hall C must be posted on the bulletin board or written on the white board at the entrance to the hall.

5.2 Hall Access

Access to the hall will be governed by the JLab Beam Containment Policy[5], and work in designated radiation areas will be carried out in accordance with the JLab RadCon Manual. In particular, no material may be removed from the hall

[5] EH&S Manual, Appendix 6310-T2.

after beam delivery without proper approval from the RadCon Group.[6] During operations, no one is allowed in the hall without either being accompanied, or informing shift personnel and checking in on a regular basis.

During a running experiment the hall will normally be in Beam Permit. When temporary access to the hall is needed the Shift Leader can ask the MCC to bring the hall to Controlled Access. If long term access to the hall is required, the Shift Leader may request the hall be brought to Restricted Access. Such a request requires prior approval from the Physics Division Liaison, while the actual transition will be supervised by the Hall Work Coordinator.

Restricted Access is a state where delivery of beam and/or RF power is not permitted, and entry to and exit from the hall is not controlled by the Personnel Safety System. This is the normal state of the hall when the accelerator is off and no experiments are running. Access is "restricted" only in the sense that the hall is not open to the general public. Well-defined check-list procedures are to be followed whenever the hall is brought to and from Restricted Access.

Restricted Access is the period when all major work must be completed in the hall. Consequently, all activities require advanced planning and must be scheduled for resources and safe operation. In order to streamline the activities in the hall and ensure everyone has ready access to the current status and requirements for work, there are two important resources:

- Single point of contact, which is the "Hall Work Coordinator"
- Information board at the entrance to the hall

All work must be scheduled through the Hall Work Coordinator. The content on the information board is the responsibility of the hall safety wardens and the Hall Work Coordinator. The information board will contain all critical information required for safe entry into the hall. This information will include a succinct, one page safety summary covering the hall's current safety hazards and mitigating measures (to be read by all persons working in the hall), active Operational Safety Procedures (OSPs) and Temporary Operational Safety Procedures (TOSPs), required temporary work permits (e.g., Radiation Work Permits), current activities in the hall, points of contact, and required training and safety equipment.

5.3 Collaboration Request for Laboratory Resources

The collaboration may request additional services from Accelerator Division through the Accelerator Division Liaison, Hari Areti. Alternatively, the collaboration may also request additional services from hall personnel through the Physics Division Liaison, Peter Bosted. These requests should be noted in the logbook. Some requests may require that an SOP, OSP, or TOSP be developed.

[6] For Hall B, approval is only required for equipment along the beamline. For Hall A, approval is not required for equipment inside the detector shielding huts.

Major, abnormal, or unanticipated configuration modifications such as stacking or movement of significant shielding, unanticipated vacuum work, unanticipated beam line modifications, the replacement of a wire chamber, etc., require approval of the Hall C Leader, Steve Wood [7], and the use of appropriate personnel. The Hall Leader may require that a SOP, OSP, or TOSP be prepared.

5.4 Scheduling of Work by Outside Groups

Work in the hall that is to be performed by groups outside the collaboration such as survey and alignment, plant services, air conditioning , etc., must be scheduled so that it does not endanger personnel or equipment or interfere with the experiment. Non-emergency activities by these groups should be scheduled to coincide with the planned accelerator maintenance periods. To maximize efficiency, the Run Coordinator (representing the collaboration) and the Hall Work Coordinator (representing Hall C) will concur on work scheduling. The Hall Work Coordinator's job is to coordinate activities in the hall so that work can take place smoothly and safely and to insure that multiple activities do not interfere.

The Work Coordinator and the Run Coordinator will meet as needed to plan the work scheduled for the upcoming maintenance period. The product of this meeting will be a list of work in the hall, the required access state of the hall (Controlled or Restricted), appropriate work control documents, and educational or other safety measures (such as escorts) that are needed.

5.5 Control of Equipment and System Status

The operation of the experimental equipment is documented in the Hall C Experimental Equipment Operations Manual. This document includes information on the normal response to alarms and equipment malfunctions. Supplementary information specific to experiment E07-002 may be found in the ESAD.

The document "Personnel Allowed to Operate Hall C Equipment" lists the authorized subsystem experts. This list may be amended as necessary to reflect personnel and training changes with the signed authorization of the subsystem expert. A copy of these amendments will be attached to the main document and kept in the Counting House.

All general equipment installation, maintenance, and testing activities are to be carried out in accordance with the JLab EH&S Manual.

5.5.1 Equipment and Piping Labeling

The experiment and hall equipment shall be properly labeled so it can be quickly identified by both shift and maintenance personnel. Proper labeling helps prevent incorrect operation or modification of equipment by non-experts and fa-

[7] Configuration changes as outlined above can affect site boundary dose and the production of airborne radioactivity. They require consulting with RadCon or EH&S personnel, as appropriate.

cilitates proper and efficient operation by qualified personnel. Labeling also increases the likelihood that proper procedures will be followed in case of emergency.

Improper labels should be corrected immediately if possible. Otherwise, the Shift Leader should be notified so that correct labeling can be requested from the qualified expert.

5.6 Independent Verification

The Run Coordinator will provide the shift crew with a set of measures for checking the quality of the experimental data. The up-to-date Hall C shift checklist (and instructions) shall be made available to shift personnel at hall-specific sites on the data acquisition computers. The checklist will be completed at least once per shift during operating shifts and once per day during standby shifts. Additional items may be added to the list by the Run Coordinator or subsystem experts.

The Hall C Experimental Equipment Operations Manual provides more general check lists for closing the experimental Hall and conditions when the Hall is used as an accelerator dump.

5.7 Logkeeping

Shift personnel will update the electronic logbook, which serves as the record of the experiment. The quality of the information recorded in the logbook determines the utility of the data. All data recorded electronically will be referenced in the computer logbook with the appropriate run number and run information. All relevant activities are to be recorded, including all changes of experiment conditions and equipment failures.

Checklists performed using Hall C-specific forms should also be scanned into the computer logbook when completed. The completed paper forms should be stored in a binder in the counting house. All deviations from normal operating parameters shall be recorded in the logbook.

The computer logbook will also serve as the primary reference for the determination of the operational efficiency of the experimental apparatus in the Hall. As such it is essential that it provide an accurate record of the capability of the equipment to carry out the intended research program. Finally, the computer logbook is the place of record for all safety issues and introductions of new or updated documentation and procedures.

5.8 Scheduling of Work during the Decommissioning Phase

The collaboration may request additional services after the experiment has been completed, e.g., for survey and alignment, target measurements, or removal of equipment. Such requests shall be made through the Physics Division Liaison, Peter Bosted, who will coordinate this with the Hall C Work Coordinator.

The decommissioning phase of an experiment will often imply major and abnormal configuration modifications such as beam line modifications, movement of significant shielding, the replacement of user-supported equipment, etc. Such configuration changes can affect site boundary doses and the production of airborne radioactivity. They require consulting with RadCon or EH&S personnel, as appropriate. Any user activities during the early phase of decommissioning that involve such a configuration modification require prior approval by EH&S personnel.

A Special Procedures for Hall C

A.1 Badge Reader Physical Access Control

General physical access to Hall C is restricted by a full time badge reader system. The badge reader limits non-emergency hall access to those individuals on the approved access lists. The Hall Leader maintains the data base, with input from the Physics Division Liaison, the experiment run coordinator, the Hall C work coordinator, the Hall C safety warden, and physics division safety personnel. As a part of the general access control the Physics Division Liaison working with the collaboration management will collect names of those who state by signature that they have read and understood the COO and ESAD.

The badge reader based security system is in addition to the engineering and administrative controls discussed previously. Specifically, to gain physical access to the hall requires the logical .AND. of all engineering based access control systems. If the hall is in a "Restricted Access" or "Controlled Access" state the maglock will release after a valid badge is scanned by the badge reader. Badges and access privileges are assigned to individuals. Each individual must scan his/her badge separately and all entries and exits are logged. Exceptions include formal prearranged and approved guided tours or escorting of a visitor who has a RADCON issued dosimeter.

If the hall is in "Controlled Access" those seeking entry must also request access with MCC (generally by the phone near the door) simultaneously with the badge scanning to unlock the outer Hall C personnel door. The MCC cannot override the badge reader's data base and a valid badge does not guarantee that the MCC will allow entry into Hall C. The badge reader's data base of authorized individuals is not static and may be modified as appropriate for the activities underway in the hall at that time.

A.2 Pivot Area Access

For many Hall C experiments, guard rails have been placed at the perimeter of the pivot area. In such a configuration, access to the pivot area only requires permission of the Hall C Work Coordinator (note that hearing and eye protection may also be required, this will be posted at the pivot entrance). For Hall C experiments that require frequent movements of the HMS and/or SOS spectrometers, the pivot guard rails may have been removed. In this case, the pivot area and access to it is in addition restricted to those individuals on the pivot area work Operating Safety Procedures (OSP) authorized list. This applies at all times including during controlled access entries. The list will be restricted to those with critical skills with a real need to access the pivot area. The access name list "gate keeper" is the Hall C Work Coordinator. All access to and work on the pivot area must be performed in accordance with the pivot area work OSP.

B Special Procedures for E07-002

For E07-002, the focal plane polarimeter (FPP) is a new detector in the HMS hut. The gas Cerenkov, aerogel and S2 scintillator planes have been removed and now the FPP spans their physical location. A scintillator, S0, has been placed between the two HMS drift chambers. S0 is used in the trigger. All of these changes were also made for the running of E04-108 and E04-019, with the exception that the S0 for E07-002 is larger than the S0 used for E04-108 and E04-019, thinner, and is mounted between the two HMS drift chambers, rather than before the first drift chamber.

On the SOS side, a large calorimeter (BigCal) has been installed. Fig. 2 is a schematic of the BigCal in the hall. BigCal will be moved to a single position and angle for the duration of the experiment, 29° and 12 m from the target. While BigCal was also used for E04-108 and E04-019, the current experiment also requires a deflection magnet so that electrons from *ep* elastic scattering can be separated from photons from real Compton scattering. The BigBite magnet, used previously in Hall A, is being installed on a stand between the target and BigCal for this purpose. Its position is fixed for the duration of the experiment.

On the HMS side at about 90°, a concrete hut has been erected which houses the electronic platform. This platform has the trigger and data acquistion electronics along with 6 high voltage crates. A schematic showing the position of the electronic platform hut in the hall is shown in Fig. 3.

Documentation on the operation of the new detectors is available at the E07-002 webpage (http://hallcweb.jlab.org/experiments/RCS/). In addition, operating instructions for shift workers will be provided in the counting house. The name and phone number of the on-site expert responsible for the each of the new detectors will be written on the whiteboard in the Hall C counting house. Changes of operational procedures or detector configuration must be made through the on-site expert and clarified by the run Coordinator and Spokepersons.

BigCal will be moved to a single angle / position during the experiment, 29° and 12 m from the target. Changes in the BigCal angle and/or position will require the hall to go to restricted access. The BigCal configuration change will be supervised by Walter Kellner and follow the standard procedures to ensure that it is carried out in safe, efficient and timely manner. Before the BigCal is moved, it must be disconnected from its local power source. This will be done by either Bill Vulcan or Joe Beaufait.

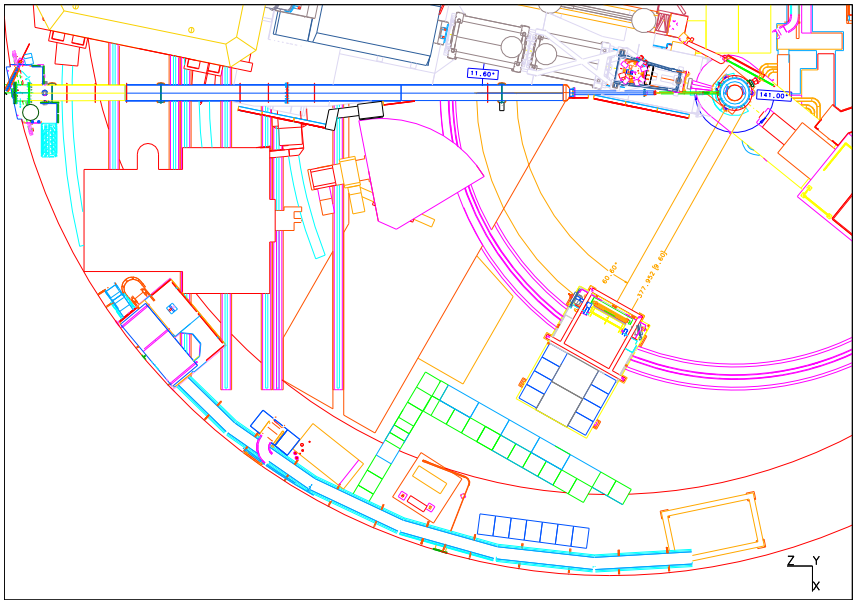

Figure 2: Schematic of BigCal in Hall C, positioned for the first G_E^p kinematic point. For E07-002, BigCal will be placed at 29°, 12 m from the target.

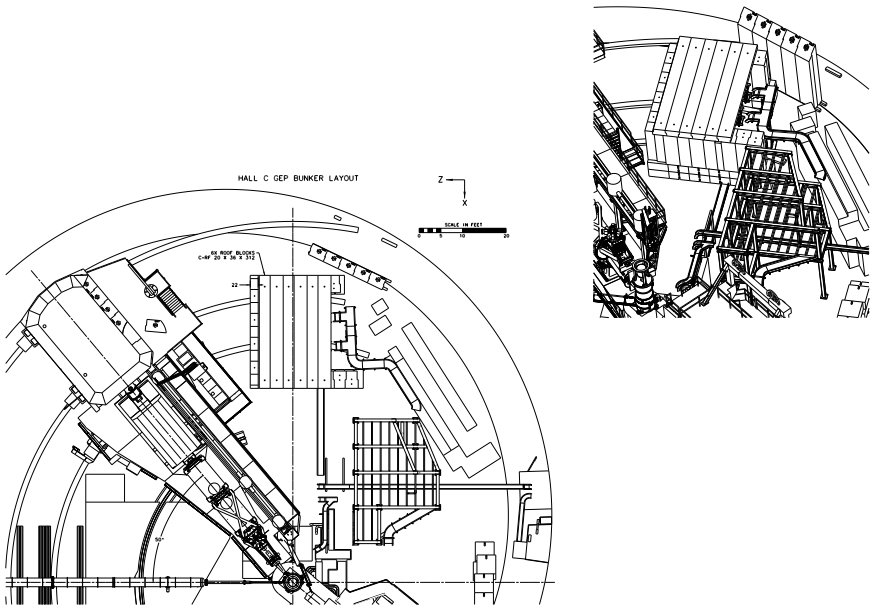

Figure 3: Schematic of the location of the hut for the electronics platform.