**CDC assembly procedure**  GlueX-doc-1280

(12 February, 2010) Updated 13-October-2010

**Introduction:**

The GlueX detector will be at the heart of a long-term collaborative research program between a large international group of researchers including scientists from CMU. The experiment will be carried out at the Thomas Jefferson National Accelerator Laboratory in Newport News, Virginia. The Medium Energy Physics group at Carnegie Mellon is one of the lead institutions in the multinational GlueX collaboration and Curtis Meyer is currently the spokesperson of the approved experiment.

In order to carry out the research program associated with GlueX, all of the institutional partners in GlueX have agreed to take on responsibilities in building the experimental experiment. Ultimately, all of these parts will need to fit together with high precision in the GlueX experiment . In order to accurately understand and simulate the response of the GlueX detector as a whole, it is necessary to have complete documentation as to the location and composition of all parts used in building the GlueX detector.

To facilitate the successful assembly of the experiment as a whole, and to document the material and its location in the experiment, Jefferson Lab, in collaboration with the institutional collaborators in GlueX have developed a complete set of drawings that fully document the GlueX experiment and are crucial to the successful completion of the research program,. These drawings, combined with the technical expertise of the various institutions and Jefferson Lab are crucial elements in the construction and successful operation of the GlueX experiment.

In the case of Carnegie Mellon, the drawings, material choices and procedures were developed by building several small-scale prototypes at CMU. The information learned for this earlier work at CMU, combined with information obtained from commercial vendors has led to the detailed drawings specified in the statement of work, as well as the assembly and quality control procedures that were developed at CMU to ensure that the detector elements built at CMU will be of sufficient quality and precision to allow us to carry out our planned long-term research program at Jefferson Lab. This document describes these the steps needed during assembly which are needed to make sure that the resulting CDC is able to carry out our research program.

**Details on the assembly of the CDC:**

This document provides a description of the planned construction of the CDC at CMU. The document will be updated during the construction procedure to provide an accurate record of the activities involved in the building of the CDC. The initial part outlines the manpower involved in the project, where the activity takes place and how we anticipate deploying the manpower. Following that are the steps that have been worked out to assemble CDC.

**Manpower:**  The primary manpower for the construction of the CDC will be two full-time technicians. These technicians will be overseen by the Construction Manager (Gary Wilkin) and assisted by undergraduate students. We anticipate the equivalent of one full time student. During the school year, this effort will be split over several students, while during the summer, it will likely be split over at most two students. We also will have scientific support for the project. This will include time from faculty members, post docs and graduate students. The anticipated manpower is shown in the table below. Those names listed “Tba” will need to be hired.

|  |  |  |
| --- | --- | --- |
| **Position** | **Name** | **FTE** |
| **Construction Manager** | **Gary Wilkin** | **0.70** |
| **Technician** | **Any Woodwell**  **Kate Mueller** | **1.00**  **1.00** |
| **Undergraduate Students** | **Tba** | **1.00** |
| **Scientific Lead** | **Dr. Naomi Jarvis** | **0.70** |
| **Post Doc.** | **TBA** | **0.25** |
| **Graduate Student** | **Will Levine** | **0.05** |
| **Faculty** | **Curtis Meyer** | **0.30** |
| **Faculty** | **Reinhard Schumacher** | **0.05** |

**Construction Space:** The primary construction space is in a clean area in Wean Hall 8409 which is 21 feet by 26 feet and 13 feet tall. The space includes storage cabinets, counter space, a sink, fume hood, 110 and 220V power, compressed air, natural gas spigots and a track to suspend things from the ceiling. Also available is a very flat 4 feet by 12 feet “layout table’’. The room also has phone and network connections if needed. One end of the clean room is an entry vestibule to minimize dust entering and provide space to put one and take off clean-area appropriate clothing. The above clean space is about 50% of 8409, and a similar space is available for work that needs to be done outside the clean area. A pass through is available between both halves of the room.

Adjacent to the construction area, in Wean 8415, is a fully equipped shop which also serves as Gary Wilkin’s office. The offices of all other people associated with the project are across the corridor from the construction area. The close proximity of all relevant personal to the construction area will provide for a very quick response to any issues that may arise without needing people to leave the clean area.

As a final note, the clean area is a steel-stud construction for the walls and ceilings which has been covered by 30mil think clear plastic (Lexan) sheets (4’ by 8’). The ceiling is below the lights in the room. The room has several low-impedance air filters to limit the dust coming into the room.

**Construction Activity:** After initial training for the various stages of the project, we anticipate that the typical construction shift will consist of the two technicians carrying out the bulk of the construction. The undergraduate students will assist where possible both in the clean area and outside the clean area. Gary Wilkin will provide the supervision of the normal activities, as well as provide training and assistance when needed in the assembly. Curtis Meyer will regularly visit the construction and check that things are going according to plan. At the various stages, where testing is needed, the Post Docs and graduate students will oversee the tests, and carry out any analysis needed.

During all phases of the construction except for the stringing of the wires, activity can easily proceed if any team member is ill. During the stringing, we will need to train additional people to be able to step in if someone is ill. On those occasions when more than one primary person is ill, we will likely incur delays in the activity. We have tried to anticipate this in the time estimates.

**Mounting and Alignment of Endplates:**

(see GlueX doc 1621 for final details.)

1. Lay endplates on a flat layout table and glue in the inner shell supports.
2. Install fixed flange onto stringing pipe fixture in horizontal position.
3. Slide upstream endplate onto fixed flange.
4. Slide inner gas window tube onto pipe and glue to upstream endplate window support.
5. Install downstream endplate onto sliding pipe flange.
6. Slide endplate/flange assembly onto stringing pipe and insert downstream window support into window tube.
7. Loosely assemble 12 permanent outside and the temporary inside endplate connecting rods.
8. Tighten all rods to upstream endplate.
9. Tighten downstream endplate to 24 connecting rods in a crisscross pattern, possibly using alternating right hand and left hand threads to reduce torque on endplate.
10. Tighten sliding flange to pipe.
11. Rotationally align endplates with transit.
12. Glue the downstream end of the inner gas window tube to endplate.
13. Install turnbuckle rods from top of pipe to ends of 12 permanent outside downstream connecting rods to support circumference of endplates.
14. Crane detector/pipe assembly to vertical position.

**Procedure for Insertion of Straw tubes into the chamber:**

1. Straws are assembled according to the Straw Assembly Detail (below) . Assemble sufficient straws for a full layer plus the close-pack layer.
2. Insert straw between endplates, aligning it with the correct top and bottom hole. The end with the aluminum donut is on the lower end. The end with the plastic donut is on the upper end.
3. Place feed-throughs through each endplate into the donut in the straw.
4. Glue the lower feed-through (aluminum) into place using conducting epoxy. Hold with tape.
5. Glue the upper feed-through (plastic) into place using normal epoxy.
6. Repeat steps 4 and 5 until all straws in both layers are installed.
7. Use alignment tool to position the center of the straws.
8. Apply spot glue joints between straws tying all straws together.
9. Repeat for the next pair of layers.
10. As needed during construction, the inner alignment rods are moved, or removed.
11. Upon completion of all layers, the outside shell is installed on the chamber and glued into place.

**Straw Assembly Details (prior to installation in CDC):**

(see GlueX-doc 1532 for straws. GlueX-doc 1533 & 1534 for donuts and feed thrus and GlueX-doc 1440 for straw insertion details)

1. Straw is selected from stock and visibly inspected for defects and flatness.
2. Straw is inspected to make sure that the donuts will fit snugly.
3. Straw is cut to the proper length using a high-speed thin-bladed saw.
4. The interior of the tube is cleaned by blowing a cotton ball through it with compressed air.
5. Donuts are inspected to make sure that they fit snugly in the tub,
6. The donuts are inserted into the straws, and glued into place. The upstream end uses and aluminum donut and conducting silver epoxy. The down stream end uses a Noryl donut and regular epoxy.
7. The holes in the donuts are covered and the straw is placed in a clean storage area to allow the glue to dry.

**Wire stringing details**

(see GlueX-doc 1441 for details see documentation for wire tension measurements details.)

The following procedures detail stringing of wires in the CDC.

1. The spool of wire is suspended above the upper end of the CDC.
2. The end of the wire is fed into the non-tapered end of a crimp pin, and pulled through.
3. The wire is then passed through the central hole of the plastic pin holder.
4. A small chain with a magnetic pin is attached to the end of the wire, and then lowered through the straw tube being strung. Sufficient wire is taken to be able to suspend a 30g weight on the wire.
5. The plastic insert is placed into the end of the straw assembly, and then the crimp pin is inserted into the plastic insert.
6. The wire is now held so that it can no longer come off the spool.
7. The lower end of the wire is fed through the crimp pin and plastic insert.
8. The plastic insert and crimp pin are inserted into the chamber.
9. The 30g weight is connected to the bottom of the wire.
10. The upper crimp pin is crimped.
11. The lower pin is crimped.
12. Excess wire is removed from both ends of the chamber.

13. Electrical connectivity of the wire is checked. If broken, the wire is restrung.

1. After approximately 30 wires, tensions checks are made and bad wires are repaired.

**Electrical Hookup of the Chamber:**

* 1. Rotate chamber to horizontal position and support endplates on bearing blocks.
  2. Install Lexan Swiss-cheese plate and downstream gas plenum.
  3. Insert wires through plate in groups appropriate for a connectors.
  4. Strip wires at appropriate length and connect to the connector.
  5. Make ground connection for the connector.
  6. Rotate vertically and glue all wire feed throughs in wire position plate.
  7. Run argon/ethane gas mix and check for leaks and reseal as necessary.

**Donut and feed through Inspection Details**

(see GlueX-doc 1533 and 1534 for details).

The following details the inspection of the donut and feed throughs.

1. All parts need to be visibly inspected for defects.
2. Parts are deburred if needed.
3. Size is checked with known dowels and holes.
4. Parts are cleaned in a ultrasound jewelry cleaner, and then stored in a clean space for later use.