CONSTRUCTION STATUS QUO
Version 1

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1. Introduction

The sequence of events for the construction of the 48 BCAL modules, as budgeted for in JSA 09-R280857-CR and in Appendices 1 and 2, is the following:

DAY-0: The notification that the contract has been approved and that hiring of personnel and ordering of materials and supplies can proceed signifies the start of the construction. This took place on August 6, 2009. Mr. Kolybaba has notified Human Resources at the UofR of his retirement and acceptance of the BCAL Construction Manager position, and this became effective on October 1, 2009. Mr. Kolybaba assumed his duties as construction manager officially on that date, although he spent considerable time as 'contributed labour' over and above what was budgeted under the Construction Prototype contract, JS 09-Q280781, and continued through the approval of the full construction contract, JSA 09-R280857-CR.

2. Infrastructure, Materials and Student Labour

2. 1 Infrastructure

By the time of the BCAL Readiness Review on November 4, 2009, the infrastructure towards the construction of the 48 production modules will be nearly 100% in place. Specifically:

- The Construction Lab facility (LB113) was possessed, cleaned and prepared over the summer period. As permanent fixtures, it includes an operational fume hood with external ventilation, a faucet and sink, cupboards, drawers and shelving for storage of consumables and lead sheets. The lab has ample space for tested-and-approved fibre storage. Two new compressed air lines with pressure regulators were installed. There are adequate power outlets. A PC running Linux and hosting the electronic log (E-log) is operational in this room. A second dedicated Linux machine is in LB123 (office). The students on both machines carry out attenuation length and photoelectron analysis. Daily backups are carried out to a remote server.
    - Status: 100% operational.
- The Lead Swager has been in operation since May 2009 in LB113 and since July 2009 in its dedicated alcove in LB113.3. Lead samples were

swaged until we were satisfied that the roller/drum positions were optimally set. Early in October the out-feed side of the table was removed and small adjustments were made to rectify a minor problem of lead snagging on the table's lip. A list of spare parts has been submitted to JLab and approved for purchasing under a separate – to the main contract – account.

- Status: 100% operational.

• Press 1 was surveyed, re-leveled and minor retrofitting was carried out to rectify errors in its construction at Edmonton. Minor leaks in the pressure manifold system were repaired.

- Status: 100% operational.

• Press 2 will be completed by October 30, 2009. It is a close look-alike to Press 1, incorporating a few improvements. It has already been leveled.

- Status: 100% operational.

• Press spare parts are on hand. Specifically, we have three spare kits for cylinder (piston) repairs and 10 valve kits.

• The Fibre Sorting/Lead Trimming Table has half its surface covered with a special rubber cutting pad where the lead coils are unrolled, cut to length and re-rolled, and the other half with a grounded thin copper sheet – that reduces static electricity build up – upon which fibres are sorted.

- Status: 100% operational.

• The Fibre Testing Lab (LB127) has been in the group's possession since year 2000 and serves as the main detector development and testing lab. To date it has been used exclusively for GlueX-related work. New wall-mounted shelving was installed in the summer for tested fibre storage. The lab has been fully instrumented to populate three test stations: a) fibre attenuation length station using a photodiode or spectrophotometer and a laptop for readout, b) number of photoelectrons station using a ^{90}Sr source, calibrated PMT, trigger counter all inside a dark box and readout by a CAMAC-based DAQ system, and, c) SiPM testing station. Spare fibre polisher parts (one diamond and two fibre stops), photodiodes, LEDs, PMTs, NIM and CAMAC modules have been procured, to accommodate potential equipment failures. There is no backup spectrophotometer, and our UV laser for the SiPM tests is decaying but these absences are deemed non-essential. No backup systems exist for a) HV crate, b) CAMAC crate, c) CAMAC controller, and, d) NIM crate. In a pinch it is possible that departmental facilities can be borrowed for the duration of repairs if this timing does not interfere with teaching requirements; a loan from JLab could also be a temporary solution.

- Status: 100% operational.

• Our Underground Lab (LY002) has been cleaned and prepared to receive overflow testing. It has its own fume hood, for storage of extra epoxy. Should module testing take place at the University this would have to be done in LB127 and then the attenuation length station would most likely have to be moved to LY002 due to its light weight and independence from a (heavy) DAQ system. The current proposal is to conduct the optical testing of machine modules at Ross Machine Shop (RMS).

- Status: 100% operational.

• Storage space for the lead has been allocated in another building. Fibres are stored in the two labs discussed above.

2.2 Materials

• 10 sets of cold-rolled steel bar pairs have been purchase and have been drilled and bored and are in the process of being straightened at RMS. One set of two bars was installed on the Construction Prototype, leaving nine sets for future builds.
• 50 Aluminum top (inner) plates have been purchased. Five have been machined: one was used for the Construction Prototype and four are in our inventory.
• 50 Aluminum base (outer) plates have been purchased. To eliminate lead time and for reasons of economy and precision, it has been decided to machine all the plates as one batch. This 50-70 working day process commenced on October 25. A contract will be signed with RMS to assure timely machining of the remaining 48 modules later. The modules will be delivered to them one at a time and stored until they have four, at which time machining will begin.
• 12 wooden shipping crates will be constructed to allow shipment of modules from the university to RMS and eventually JLab. Two of these will be ready by November 30 and two more before Christmas, to allow the shipping of the first four modules to RMS. Details on returning the crates from JLab are still being worked out. It is possible that more crates may be needed. The crates must be strong enough to protect the modules during shipments and to withstand repeated trucking because they will be re-used. With the construction period spanning nearly three years, thermal protection of the modules will be incorporated. A contract with the already identified transportation company will also be arranged for the duration of the shipments.
• Fibre shipments from Kuraray arrive like clockwork. We currently have nearly a quarter (200,000) of the entire number of fibres required. The delivery schedule has three more shipments of 24,000 fibres each arriving before the end of the year. This will give us enough fibres for 16 modules, an enormous safety margin at this stage.
• Lead shipments from Vulcan will be broken into four shipments. The first one has been received and is of very good quality. The last shipment will be received in April 2010. That will be the lead for all modules. Currently we have enough lead to complete 25% of the number of modules. No issues or concerns exist here.
• Four 1-gallon Bicron 600 epoxy kits (resin plus hardener) were received over the summer and used up in the build of the Construction Module. Two more 1-gallon kits were received in September and six more on October 26, 2009. An additional 10 kits have been requested by December 1 and 20

more by the end of the year. Following this, BICRON has been notified of our delivery schedule for the duration of construction to assure a supply of freshly made epoxy will be available in a timely fashion. The plan is to have enough epoxy on hand for a two-month (four-module) lead in the schedule, in order to accommodate unscheduled interruptions of shipments without exceeding the shelf life of the contents.

- Industrial two-component epoxy is at hand (six quarts with a three-year life span) and is adequate for the construction of several modules. The precise amount required will be known after completion of the first two production modules.
- Consumables (ethanol, wipes, plastic cups and spoons, etc) are available either from Science Stores or retail stores. The supplies are checked and replenished every Friday.

2.3 Labour

Five physics students were employed in the summer of 2009 to work primarily on the Construction Prototype (Contract JS 09-Q280781) but to also test production fibres from the first three shipments. Two of those students stayed on with the group, each 1/2 time, for the September-December 2009 period, thus bringing some continuity to operations. Five Engineering students were hired in September 2009, four on one-year industrial internships and one on an eight-month Co-Op work term. The current five students are now well trained in all tasks due to crew rotation through all tasks:

I. Fibre quality assurance
    i. Attenuation Length station (photodiode and spectrophotometer)
    ii. Number of Photoelectrons station
II. Matrix Construction
    i. Lead cutting and swaging
    ii. Fibre sorting
    iii. Epoxy mixing and application
    iv. Fibre laying
    v. Lead rolling

With the SciFi's and the Pb arriving at the UofR at the scheduled dates, the students have been prepping, cutting, swaging and stockpiling Pb sheets, and have been doing the QA of fibers. Well over 300 lead sheets of the different widths have been processed to date, and random testing of fibres from the first five shipments has been concluded and these fibres are suitable for the construction process. This mode of operation allows a careful start to the construction of the first two modules and will eventually speed-up the construction process and/or allow for double shifts in the event of delays.

Additional crew includes the Construction Manager, two faculty members, one research scientist, two graduate students with previous construction experience (only until April 2010 when they graduate), and two undergraduates with

experience from the summer 2009 crew that are available on an hourly basis in the event of illness or absence of members of the main crew. Other physics undergraduates can be recruited hourly, after training.

3. Construction of Modules

Module 1 construction started on November 9, 2009, approximately three months after contract approval. Based on a two press-frame availability and based on a five-day work- week, two modules will be constructed every month. Double shifts have been tried successfully during the build of the Construction Prototype and are an option in the event of mechanical or other delays in construction. It should be stressed that absolute priority is assigned to all aspects of the construction, implying that the students assigned to fibre QA may be pulled for duty on the construction to combat delays, at the expense of testing fewer fibres.

After inspection and documentation, the modules will be shipped to RMS one at a time and stored until a fourth arrives and then machining of the four to final dimensions will commence. Rough and final machining operations for four modules will take approximately two weeks for four modules. Therefore, from start of module construction to be ready for shipment to JLab, three months will be required. This includes the final inspection and documentation, as per QA Plan, of the finished modules at the UofR.

4. Final Remarks

Before the contract was awarded, the most worrisome issue for the project was being able to secure adequate student labour. This has been secured for the first year of construction. We have implemented the hiring of two half-time physics students this semester, who submit their availability schedules on a dedicated project calendar to monitor staff shifts. These two students work partially during working hours but also on evenings and weekends, mainly testing fibres, and have done all the work in developing the optical testing system. This has paved the road for other such hires in the future if necessary. We also are currently investigating the hiring of recent physics graduates from our B.Sc. and B.Sc. (Honours) programs for the last two years of the project.

Otherwise, everything is in place and 100% operational for the smooth construction of the 48 modules. Of course, time will tell, but we believe we have built up spare capacity, have spare components and are experienced to handle any type of conceivable problem.