HPS Response to the Committee Report for the HPS Experiment Readiness Review conducted on July 10, 2014 at JLAB.

HPS Collaboration

August 8, 2014

This document responds to the Key Issues and Recommendations contained in the Committee Report (7/28/14) from the HPS Readiness Review. We thank the committee for their time and thought in conducting the review, and in preparing their recommendations. The process has been useful for HPS in preparing to commission beams and detector, scheduled for Fall 2014.

In the following, each of the enumerated key issues and recommendations from the report are presented in italics, followed by the HPS response.

1. *The collaboration has developed a detailed construction, installation and commissioning plan with clear milestones identified. However, the time allocated for the activities seems short considering that the run is only on night and weekends. The collaboration is encouraged to be flexible to adjust (meaning increase) their initial shift staffing consisting of only a shift leader and shift person and thus only a two person shift setup. The committee suggests a re-evaluation of the schedule to in order to validate that it is consistent with running only on nights and weekends.*

   We agree that running only at nights and weekends poses many challenges. Our estimate for run efficiency is 1 PAC day = 4 days on the floor. We used PAC days in our estimates for the commissioning and data taking time and we believe 4 PAC days for beamline commissioning for HPS (after reasonably good physics quality beam is delivered to Hall-B dump) and 7 days for detector commissioning should be sufficient. We believe that simply increasing shift staffing with experts is not the most efficient way to run, especially since our running will stretch out over a long period. Instead, we will support those on shift in two different ways. First, during the commissioning of each subsystem, the subsystem leader or deputy will oversee the necessary tasks and procedures. Second, once commissioning is complete, subsystem experts for each of the detector subsystems (Beamline, SVT/SVT DAQ, ECal, TDAQ, Slow Controls) will be available on site at JLAB to help. The HPS Run Coordinator will provide additional continuity and direction for shift takers.

2. *The committee recommends that the collaboration and laboratory consider allocating larger blocks of dedicated running time to the experiment if and whenever possible. This should improve productivity and allow a stronger concentration of expert manpower on site during data taking. It would also save a significant amount of travel (and the associated expense) incurred by the HPS offsite collaborators.*

We agree that running without interruptions whenever possible is a big advantage and will ask lab management to consider continuous running if the gain in efficiency is significant. It should be noted that in the HPS implementation plan proposed by the lab management the allowed time for HPS to run is defined as follows: *"Running would occur during evenings and weekends or during other periods when it would not conflict with the regularly scheduled assembly of the CLAS12 Torus coils."* So blocks of uninterrupted running time may appear. Anticipating the appearance of such opportunistic running, the HPS collaboration has decided to maintain shifts 24/7 for the whole period allocated for us. So we are already prepared to run beyond the nights and weekends originally scheduled. It should also be noted that in the initial phase of the commissioning, having some breaks in the schedule could even be advantageous, providing us more time to analyze and fix any problems encountered.

3. *The present optics configuration allows for 1 mm of leakage dispersion in either plane. This needs to be revisited for this experiment (see detailed comments above). The collaboration should also consider implementing an energy lock based on the vertical dispersion in the Hall B ramp.*

Accelerator operations and Hall-B are in the process of revising the Hall B beam delivery procedure. We will work closely with machine optics and operations experts to find the best possible options for safe and efficient operations, including changes that could help mitigate the effects of beam trips.

4. *The primary danger to the SVT appears to be mis-steered beam, which could short out the detector diodes and damage the front-end electronics. This is mitigated by a 2 or 3 mm collimator located upstream of the target, and beam dump interlocks based on halo counters. The experiment expects to test the interlock systems as part of the commissioning utilizing wires that project toward the beam from each SVT assembly. This procedure needs to be thoroughly tested and understood.*

The FSD interlocks include not only the Hall-B halo counters but also pair of Beam Lost Monitors (BLMs) provided by accelerator. The set of halo counters and BLMs will be mounted downstream of the SVT protection collimator. The system will be thoroughly tested after a stable beam is established on the 2H03 harp and the SVT protection collimator is aligned. This will be done at the end of the beamline commissioning, well before moving the SVT near the beam, putting voltage on the sensors, or powering the SVT electronics. The test will include moving the beam up and down using vertical correctors on 2H00 and recording its vertical position on 2H01 and 2H02 BPMs and the corresponding rates on the halo counters and BLMs as the beam is moved. These rates will change when beam gets closer to the collimator edges (the beam tails will interact with the collimator). The FSD trip limits can be set to limit beam vertical motion based on these studies. The procedures are included in the HPS beamline commissioning document.

5. *The SVT silicon detector will be operating in a radiation environment that is rather unique compared to most silicon-based. There will be a large electromagnetic and rather small neutron background. This leads to several concerns: The in-vacuum readout system uses commercial off the shelf electronics, which have not been qualified for the levels or mix of radiation present in the HPS experiment. There is the possibility of single event upset, single event latchup or total dose related failure when the experiment goes to high flux.*

The HPS front-end readout chips on the hybrids are used in an LHC detector where they have been subjected to a much harsher radiation environment than that at JLAB, so they are not considered vulnerable in the JLAB environment. Radiation tolerance studies of commercially available FPGAs, which are deemed the most sensitive item on the Front End boards, are being actively performed for high luminosity LHC operations. These studies have already demonstrated that similar FPGAs are robust at radiation levels in excess of 100 krads. On the other hand, the expected dose at the FE boards from x-rays (mostly L-shell x-rays) from the HPS target is at most at the 50 rads/hour level at 200 nA. To be conservative, we plan to install a 2mm-thick copper or titanium plate in front of the FE boards to absorb x-rays, further reducing the flux by two orders of magnitude.

The neutron background is described in RSAD. We plan to install 50cm-long shields inside the first Frascati magnet on either side of the beam pipe to absorb neutrons produced in the collimator, reducing the neutron flux at the FE boards by two orders of magnitude, bringing them to a negligible level. It is more difficult to handle neutrons from the HPS target as the space is very limited. We are evaluating neutron shield options, but note that the flux is expected to generate only 0.1 SEU/day in the Front End Boards, so is not considered a serious background. Even so, we'll add shielding if it is practicable to do so.

6. *SVT system will be tested for several weeks at SLAC before delivery and at JLab for a similar period. The committee recommends that a detailed plan for having the SVT readout in place and tested should be produced with a full detector test, including SVT readout electronics (even if there is no SVT detector) taking place at least a month before beam. Such an extended testing period is wise and provides some buffer period to solve possible problems. The relative ease of access to the SVT system also provides some flexibility to address problems after installation.*

A detailed plan exists and is outlined below. Our SVT system tests have been staged as more and more hardware has become available. A summary of the tests we have already conducted and our plans for future tests leading up to installation on the beam line follows:

(A)[DONE] The SVT readout crate has successfully handled the simulated occupancy of the full SVT at rates many times higher than expected in HPS. This test was independent of CODA.

(B)[DONE] A single ROC SVT readout integrated with CODA has handled the expected SVT occupancy at data transmission rates >75 kHz.

(C) [EXPECT 8/15/2014] The full JLab DAQ electronics will be integrated with the SVT DAQ allowing multi-ROC trigger interfaces to be tested at high data rates. These tests will be conducted August 11-15 at JLAB with SLAC SVT DAQ experts working directly with JLab DAQ experts.

(D) [EXPECT 9/15/2014-10/15/2014] The final stage of testing at SLAC, with the full SVT, will establish the noise and overall electrical performance of the system as a whole.

Taken together this plan will ensure that adequate time is available to catch and address new issues should they come up. Notice the expected completion date is more than a month before we anticipate getting the first beam in the detector, November 22, 2014.

7. *The computing requirements appear to be on the same scale as those for Hall D – which are significant.*

Our present computing and storage requirements reflect the considerable time required to reconstruct and store all our triggers. This is a conservative approach appropriate for the first stages of HPS when we are confirming that everything is working correctly. We will reconsider if the approach should be continued for the whole experiment, or if it is desirable to store only selected events.