**NPS Collaboration Responses to: NPS ERR Committee Comments on NPS Collaboration Responses to the ERR Report**

**Charge #1**
A draft of the run plan for both Run Groups have been presented with the ordering of kinematic settings as they are plan to run. The ordering takes into account equipment radiation, in order to optimize changeover time. However, the question of the priorities between the settings have not been addressed.

- **NPS Collaboration response**: The PAC judged the scientific need for all various kinematics settings, the priorities between the settings is a collaboration matter, and these priorities have been explicitly stated in our previous responses in the Table 2 and Table 3 captions. Further, operational constraints (e.g., scheduling constraints imposing beam energy and Hall current limitations) often come in and will be resolved in discussions with the hall leader and the scheduling committee.

**Charge #3**
It is understood that no threshold will be used for the readout of individual modules. Thresholds, rates, and energy resolution must still be determined for the trigger to function in an efficient and meaningful way. We are not aware of an existing firmware that allows to effectively set FADC readout thresholds independent of trigger.

- **NPS Collaboration response:** The firmware is being developed in collaboration with the Fast Electronics Group.

Answer to the question of rates states "... the maximum rate in the calorimeter will be smaller than 1 MHz per module …". What threshold this maximum rate corresponds. As was mentioned at the review, for one of the settings of PR12-14-003, the rate of e-, \gamma, e+ with energy > 1 GeV was estimated to be 1.2 MHz. It is important to know how high the rates of much lower energy particles will be that will pass the threshold for the trigger formation and how this rate translates to a rate per module

**NPS Collaboration response:** In our reply, we had addressed the case that we had thought was asked for by the ERR committee report, the E12-13-007/010 run group where the energy resolution is more critical and the calorimeter is operated at small angles below 10 degrees, with high rate. For these, background rates came from our realistic simulation studies (see Appendix A of https://www.jlab.org/exp_prog/proposals/13/PR12-13-007.pdf, e.g. Fig 12). Here, the question of rate per module is related to E12-14-003, the other approved run group experiments with similar setup (but with a radiator). The rates for E12-14-003 are shown in the table below. Based on detailed studies we did for the 6 GeV energy range (see the attached article - Fig. 19), we find that the rate is proportional to exp(-9E/E_max), where E_max is the RCS scattered photon energy. This will be very similar for 8.8 and 11 GeV. For kinematics 4E, E_max is 3.25 GeV and the rate is 1 MHz at E = 50% of E_max or 1.6 GeV. The threshold will thus be set to 1.6 GeV for kinematics 4E and higher for the other kinematics. Now we can find the rate at any threshold e.g. at E = 0.5 GeV the rate will be 21 MHz (full calorimeter of 1000 crystals). The upper limit for the rate in a 10-crystal cluster at 0.5 GeV threshold is 0.2 MHz and the energy flow is 0.005 GeV per 50 ns time window. Using the formula above we find that such a shift of the base line leads to a change of the trigger rate of 2.5% - from 1 MHz to 1.025 MHz. For a threshold of E=0.25 GeV the rate is higher (44 MHz) but the base line change is the same and the trigger rate change is also the same. Overall the rate is thus 84 MHz * exp(-9E/E_max) total in 1000 crystals and the impact for the trigger rate is 1-2%.

| Kinematic Setting | Beam Current [uA] | HMS Angle [degrees] | HMS Rate [kHz/uA] | HMS Rate [kHz] | NPS Angle [degrees] | NPS Rate [kHz/uA] | NPS Rate [kHz] |
|---|---|---|---|---|---|---|---|
| 4A | 5 | 40.1 | 0.03 | 0.15 | 14 | 79.4 | 397 |
| 4B | 15 | 33.7 | 0.07 | 1.1 | 18 | 51.0 | 765 |
| 4C | 30 | 27.8 | 0.14 | 4.2 | 22.5 | 31.7 | 951 |
| 4D | 60 | 23.7 | 0.42 | 25.2 | 27 | 15.2 | 912 |
| 4E | 60 | 18.9 | 0.78 | 46.8 | 34 | 3.6 | 216 |
| 5A | 15 | 41.7 | 0.01 | 0.15 | 11 | 23.2 | 348 |
| 5B | 40 | 35.3 | 0.02 | 0.8 | 14 | 15.9 | 636 |
| 5C | 60 | 30.0 | 0.03 | 1.8 | 17 | 10.7 | 642 |
| 5D | 60 | 26.3 | 0.06 | 3.6 | 20 | 6.8 | 408 |
| 5E | 60 | 17.8 | 0.13 | 7.8 | 30 | 2.1 | 126 |

**Charge #4**

Clear explanations of which magnets are under accelerator control and which are controlled by the Hall C are given. But the question of who will be in control of the NPS magnet is not answered. The statement in the response says “The NPS magnet **can be** owned and controlled by Hall C”, is it “can be” or “will be”, and who will write the procedures for operating the magnet.

- **NPS Collaboration response:** ownership of beam line elements implies that the NPS Collaboration will do the documentation - still MCC can in the end desire to take the control/"ownership", there are precedents of that.

**Charge #7**

The simulations performed in 2013 do not appear to include the effect of the radiator on the doses. In particular, the combination of the radiator and sweeping magnet may significantly impact activation in the area around the calorimeter. Dose to the calorimeter may also be affected, though perhaps not drastically. Similar configurations in other experiments have incorporated shielding around the radiator. The possibility of some shielding between the radiator and the target was discussed in the PAC proposal, but no discussion of this was included in the ERR presentation. A new study of the radiation background is underway with the help of the radiation control group. These simulations should include evaluations of added shielding at the radiator. The results of these simulations may indicate a need to develop a method for magnet/calorimeter position adjustments that reduces the need for manual rigging and hence time spent in the area by personnel. Work being conducted by IPN-Orsay to evaluate radiation dose to the PMT bases should also take the radiator into account.

- **NPS Collaboration response:** The possibility of local shielding between the target and the radiator will be considered and implemented in consultation with the JLab target group. In various spectrometer experiments it was hanging just in front of the target ladder, in the scattering chamber without shielding. For the set of run group experiments the ERR committee discusses here, the magnet angle is fixed and the (much easier to vary) distance only changes twice between 1.9 and 1.4 meters, at relatively large angles (see Table 3 of our earlier response).

**Charge #8**

Details of the trigger validation using a random trigger with beam will be helpful. Also, it is necessary to develop a software for the simulation of the trigger firmware operation to validate the trigger performance.

- **NPS Collaboration response:** The previous response was prepared in consultation with the Fast Electronics Group and addressed the original recommendation of the ERR committee about the trigger simulation software. We will continue to work with the Fast Electronics Group to develop the trigger firmware.