Subject: Beam Current Interlock for ERL Low Power Test


The purpose of the meeting was to review the status of the beam current interlock that is to be used in the ERL low power test that has received an exemption from the ASO for an ARR review. The beam power must be kept below 70 Watts in an hour.

The Chair of the committee expressed concern that if there was an ASE violation of the 70 Watt limit it may have undesired consequences for the Department, even though there is no associated safety issue. The interlock and associated operations procedures are the main means of keeping the machine below the power limit. After initial operations it is expected that four chipmunks in the interior of the enclosure will be able to limit the beam power by detecting beam losses. However, it will take some initial effort to configure the system.

Ed L. addressed the issue of the current limit for the RSC and how it should be considered. He noted that the ICT interlock is not considered a Credited Control. Rather the interlock and procedures are considered part of a configuration management system to ensure the operational parameters are such that the machine will not operate with a beam power of more than 70 Watts. The indirect interlock on the power limit is not to be treated as personnel protection. The potential for unacceptable radiation exposure must remain below the limits provided by the C-AD shielding policy, and must be controlled by shielding and the ACS / Chipmunk personnel protection interlocks.

Ray K. went over the conditions of section 5.1 in OPM 2.5.6, which is the procedure for maintaining the ASE for the low power test. The RSC previously reviewed this section.

The tests are expected to be conducted a beam power of 7-10 Watts. The 70 Watts of beam power used as the ASE limit was to provide plenty of margin between the desired operating power and the ASE limit. The ICT and Faraday cups were both mentioned as

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1 [http://www.c-ad.bnl.gov/ESSHQ/SND/OPM/Ch02/02-05-06.PDF](http://www.c-ad.bnl.gov/ESSHQ/SND/OPM/Ch02/02-05-06.PDF)
interlocking devices in the previous minutes. However, OPM 2.5.6 only requires one interlocking current monitor. It was decided that focus should be given to one device and since the beam must go through the ICT that the ICT should be the interlocking device. The ICT interlock is provided by the Machine Protection System (MPS). The Faraday cups will be used to cross check the ICT and transmission efficiency of the beam.

The previous minutes note that the controls system will check the operating parameters to ensure that the operator inputs operating conditions that will generate a beam power of less than 70 Watts. For operations at 70 Watts or less the dose rates external to the shield are expected to be small. If the 2 MeV beam has a beam power of 10,000 Watts the dose rate on the roof for a fault condition would be 20 mrem/hr. The roof is an area that is excluded of personnel so no exposure is expected.

The committee discussed some potential alternatives to the ICT. The OPM and C-AD SAD allow the use of authorized alternatives. OPM 2.5.6 can be changed to include such changes with the appropriate reviews. The committee also discussed some of the potential weaknesses of the designed system. It is expected that the operators would notice such failures and respond in sufficient time, according to a written procedure, to prevent a violation of the power limit.

The present laser system will support a gun current of 50 mA if the cathode has a Quantum Efficiency of 1%. It was noted that the best QE for such cathodes was 8% under much better conditions. This cathode has a substrate of copper and the expectation is a 1% QE. The attenuator in the laser system would further reduce the current.

M. Wilinski conducted a power point presentation that had been provided to the RSC before the meeting. The ICT has a calibration pulse with four different levels to span the range. The electronics has a 3 bit input for gain, which provides for eight different gain settings. The range of the calibration pulses to the gain selections will be examined to make sure that they suitable.


The eight-channel integrator is a change to the system and receives triggers from the V202 board, which are a mature and reliable design in use at RHIC. The change to these integrators allows the ICT to have a high percentage of live-time and removes the 6.9 micro-second limit in the Bergoz electronics. The electronics and associated crates will be located in the support building immediately outside the shielding. The activities in this area are specific to the ERL operation. The electronics should have appropriate labeling so that personnel working in the room do not inadvertently change the configuration of the support electronics for the ICT. The change in electronics occurred after the engineering review and should be reviewed before use.

http://www.c-ad.bnl.gov/esfd/RSC/Minutes/8_1_13Minutes.pdf

See minutes in reference 2

See minutes in reference 2

M. Wilinski, PowerPoint presentation, Nov. 13, 2013
The system relies on signals and the appropriate time between signals. The reset and start timing are important to ensure proper integration of the signal. These will be established with the early setup of the ICT. The integration time now has the freedom to be as large as need to provide for monitoring the current and providing an interlock. A initial configuration procedure and test procedure will need to be written and reviewed for the ICT and its interlock.

A list of procedures will be generated and checked for providing the necessary responses to alarms, interlocks and indications that a problem is developing. One procedure will need to ensure that the correct systems are operating and logging the data from the ICT and Faraday cups. The logging from the ICT should be done at least hourly so that the beam current and power can be demonstrated to be less that the hourly limit. Some logging by operators will be done in their electronic log. Part of this review will include material that was provided by W. Xu before the meeting. There was not sufficient time to review the material.

The committee recommends that the system be used for providing a beam current limit based on the discussion presented earlier in these minutes.

Final details of the ICT system will be reviewed by a sub-committee of M. Minty, A. Etkin, D. Beavis, and C. Theisen

It should be noted that this low power test will require an RSC check-off list that is substantially different from the one used for cold emission tests. The low power test will be the first time beam has been generated inside the enclosure.

The low power beam test is expected to start in the second week of December. The exemption allows for seven months from the initial beam. However, there is great priority to conduct a gun test up to 500 mA to the actual beam dump and no acceleration by the five–cell cavity in the early spring. Therefore, the time for conducting the low power tests will be limited. A full ARR is being planned for the high current test. Data and experience from this low power test are expected to be very beneficial for the high current test.

CC:
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Attendees
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