

Radiation

Safety Committee

Minutes of RSC Subcommittee of July 15, 2014

Subject: Closing Open ERL Item

Present: D. Beavis, R. Karol, B. van Kuik, M. Minty, C. Theisen, J. Sandberg, P. Bergh, E. T. Lessard, J. Reich, and D. Kayran

The meeting was called to discuss closing open issues and resolving open issues for ERL for both the gun to dump operations and five-cell cavity with ring operations. The meeting primarily focused on the gun to dump commissioning since the ARR will occur in two weeks.

A Powerpoint presentation¹ was used to guide the discussion. Two memos were issued this week to provide information on closing out items and another memo was updated to clarify issues.

The committee agreed on the closure of all the items from the June 25, 2014 meeting² except:

1. The ATS item for phased approach to study/protect personnel from the imperfections. This will be part of the commissioning plan/sequence and is expected to remain open during the gun to dump commissioning.
2. The best shim materials will more an issue for 25 MeV beam and can remain open till the Oct. closure date.

An open item from the IRR is to have a document that explains the rationale for the location of the chipmunks. A memo³ has been written and distributed discussing where the chipmunks were located and their sensitivity to various beam faults. This item is considered closed. Some discussion on the memo occurred. The chipmunks should limit losses for 3.5 MeV beam to less than 100W in the low energy transport. When beam studies are conducted consideration must be given to the actual energy of the beam.

**The committee recommended moving the North gate chipmunk to the opposite wall to make it more sensitive to beam faults as per the memo.
(CK-ERL-Phillips& Beavis-July 28, 2014-903)**

¹ D. Beavis, http://www.c-ad.bnl.gov/esfd/RSC/Minutes/References/erl_071614.pdf

² http://www.c-ad.bnl.gov/esfd/RSC/Minutes/06_25_14Minutes.pdf

³ http://www.c-ad.bnl.gov/esfd/RSC/Memos/ERL_7_15_14.pdf

The miscellaneous shielding changes were presented in the memo⁴ of July 25, 2014. Full beam faults in the extraction line to the beam dump can create large dose rates on the roof. Two examples for dose out the shielding of the ODH vent were on the order of 75-100 rads/hr for a 1 MW loss⁵. No one expects such a loss to continue without the machine breaking but without engineering details the committee usually uses this extreme. The dose is at least 15 feet above the ground and directed upwards. Chipmunks should terminate such a beam fault in a few seconds. The areas with 75 rads/hr are not occupied and the C-AD shielding policy is met if low intensity operations prove that the chipmunks are sensitive to the beam fault. If shielding⁶ is added then the potential change to the sensitivity of the chipmunks must be taken into account.

Mis-steering of the last dipole in the extraction line does not appear to be an issue. A fault study should be conducted to examine the dose rate especially on the south side of the Klystron power supply building.

The potential mis-steering of the first extraction dipole to 45 degrees could create 11 rads/hr in the power supply building for 1MW at 3.5 MeV. It will be verified that the maximum bend is 45 degrees. **(Ck-ERL-July 27-Beavis&Phillips-904)**

The addition of a credited control may be required to prevent lower energy beams from creating unacceptable dose rates outside the building due to mis-steering by the first extraction dipole. The options are:

1. Place a small Pb shield designed to prevent lower energy beams from creating unacceptable levels outside the shielding.
2. Verify that the chipmunks already prevent this hazard from exceeding the C-AD shielding policy.
3. Provide a dipole interlock that requires the dipole to be close to the necessary bending power for the beam energy.

A 3.5 MeV beam with 100 Watts of beam power creates 10 mrads/hr at a foot if it strikes four feet of light concrete at 90 degrees. Low power beam operations can operate without undue hazard to the area south of the klystron power supply building. An initial low power beam fault study will be used to select a solution suitable for all beam energies.

Select means to protect against fault from first extraction dipole with low power beam. (Ck-ERL-Sept. 1, 2014-kayran&Beavis-905)

The committee recommends that the nearby vertical seam (referred to east 5) in a previous memo⁷ have Pb covering it. **Four inches are presently planned and will be verified for the vertical seam discussed in the memo. (CK-ERL-July 27, 2014-Phillips&Beavis-906)**

⁴ http://www.c-ad.bnl.gov/esfd/RSC/Memos/ERL_7_14_14.pdf

⁵ It should be noted that the ASE limit is 1.5 MW.

⁶ Internal to the erl enclosure.

⁷ http://www.c-ad.bnl.gov/esfd/RSC/Memos/ERL_Holes_5_27_14.pdf

The beam dump can create 620 mrads/hr out the roof transition downstream of the beam dump⁸. This would be a routine dose rate when the facility operates at full power. The dose rate will be measured at low power. If another roof beam is added then the 620 mrads/hr would be decreased to 2 mrads/hr. The decision to delay improvements is to allow studying the interplay of radiation leakage from the beam dump and the ability of the radiation monitors to detect losses in the beam transport. It is suspected that shielding will be added on the sides and possibly the top of the beam dump.

The photons radiation out the west side of the beam dump creates 40 mrads/hr inside the Klystron power-supply building. This area is excluded of personnel but the dose rate could be several mrads/hr in the walkway. The low intensity commissioning should examine the dose rates and determine the amount of shielding to reduce levels to be ALARA. If additional shielding is added over the beam dump inside the enclosure it may alleviate the need for additional exterior shielding on the roof.

There are advantages and disadvantages to places all the main dipoles into interlocks. It was decided that the vertical chicane dipoles and the extraction dipoles will have their leads RS LOTOed by the RSC Chair at the power supply for configuration control.

Ck-ERL-July 24, 2104-Beavis&Phillips-906) RS LOTO the chicane and extraction dipole leads at the power supply.

Note added after the meeting. The Chair strongly believes that the dipoles should be interlocked with an appropriate tolerance even if the radiation monitors can detect all fault conditions. This will be pursued with the engineering staff.

The project has resisted interlocks on the dipoles since they believe they will interfere with their special modes of operations. It has been noted that a special modes key switch could be included in the interlock system which would remove the dipole signal from the interlock logic but substitute their function with another credited control such as dedicated chipmunks with low interlock levels or after special shields have been put in place. The project has less objections to the dipole current interlocks if this is possible.

The polarity check on the dipoles should be conducted with a documented process. This is becoming a common requirement.

(CK-ERL-Kayran&Phillips-July 27, 2014-907)

It will be difficult to make efficient radiation measurements with the gun solenoid heat limitations. At present the solenoid can only be on for 5 seconds and then turned off for a minute. This creates a duty factor that will make measurements cumbersome. Some means were discussed on how to alleviate this issue for the exterior radiation measurements.

A means to provide an audible signal that is generated by the trigger should be pursued to allow the RCT to time their measurements with beam on.

(Ck-erl-July 27, 2014-Theisen&Kayran-908)

⁸ The dose rate is expected to be conservative since the estimate uses TVLs.

There is an open committee item to review any special modes of operations that the project would like to use. Four special modes of operations have been noted to the committee. All these modes would operate with 10 Watts of beams of less. The modes are:

1. Beam to the end of the first straight section.
2. Beam bent by the first dipole into the downward section.
3. Beam bent by the first two dipoles but the third dipole off.
4. Scraping beam along the transport to “calibrate“ the Machine Protection System (MPS).
This would be in both the low energy transport and the ring.

Interlocks on the dipoles would allow these modes if there was an ACS switch that allowed the system into special mode of operation and the dipole interlock protection is replaced by a suitable control or credited control.

The committee discussed whether there was any benefit to placing the chipmunks in both PLC system of the ACS. It was decided that this offered little or no benefit. The beam loss studies should determine that if there are whole body dose rates greater than 1 rem/hr in an occupied area that there is another radiation monitor that would also terminate the beam fault. Whole body dose rates above 10 rem/hr will be reviewed on a case by case basis by the committee. This will be part of the comprehensive fault study review.

The committee understands that the ERL system is not ready for immediate operations at a power level of 1 MW. However, the plan is to operate the gun in careful deliberate steps starting with low power and improving the system in increments. The process of incrementing the machine slowly in beam power is described by the commissioning/sequence plan which the committee will review next week. It will be important that as changes are made to allow the system to operate at higher power levels that the processes to change shielding, interlocks, chipmunks, procedures and other controls are followed carefully.

CC:

RSC minutes file
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Attendees
I. Ben-Zvi