C-AD

Radiation Safety Committee

Issued: August 21, 2006

Minutes of Radiation Safety Committee of August 10, 2006

Subject: ERL Critical Devices, Klystron Room, and Fault Protection

Present: D. Beavis, A. Etkin, P. Bergh, I. Ben-Zvi, K. Yip, I.-H. Chiang, R. Karol, L. Ahrens, N. Kling, D. Phillips, B. Oerter, P. Cameron, B. van Kuik, A. Zaltsman, and V.Litvinenko

Klystron Room Access Protection and Shielding

The Klystron room shielding was based on the operation of a similar Klystron at Los Alamos, which had a 1/8 inch lead "garage" over it. For the energy range of the x-rays the 1/8 inch of lead is equivalent to 2 inches of steel or less. The Klystron room is a steel box with a wall thickness of 2 inches of steel. There are penetrations in the back wall for utilities and the wave guide. These penetrations will be shadowed by steel of lead to prevent x-rays from directly shining out of the penetrations.

(CK-ERL-2006-485) Before operation of the Klystron the shielding prints need to be reviewed and signed. The review should examine the actual design for cracks and penetrations along with the any shadowing plates.

TLDs were attached to the Klystron during testing at the vendor (see attachment 1). Based on these results the committee recommends that the room does not require interlocks, but should have no access with the Klystron operating.

(CK-ERL-fy2006-486) A Kirk-key system will be used to control access to the room. The power to the klystron will be required to be off via the Kirk key for personnel to enter. The Kirk-key system is also an electrical safety requirement.

(CK-ERL-FY2006-487) The room will be posted as a high radiation area with beam on.

(CK-ERL-FY2006-488) Surveys will be conducted around the Klystron room before personnel are allowed near the steel enclosure. Attention should be given to any penetrations and cracks.

It is recommended that measurements inside and around the steel room be conducted to gain operational history on the radiation doses (probably will TLDs).

Critical Devices

The committee discussed the critical devices for ERL. A proposed list provided by J. Reich was considered (see attachment 2).

The potential radiation sources are the electron gun, the five-cell cavity, beam losses from the 3.5 MeV beam, and beam losses from the 25 MeV beam. The x-rays from the gun and five-cell cavity are expected to be more that 50 rads/hr at a meter. Therefore, dual interlocks and shutoff devices are required for all radiation sources.

(CK-ERL-FY2006-489) The Klystron will be turned off with two 4160V contactors. The internal contactor can be used as one of the critical devices provided that it is reviewed as suitable and the soft start does not defeat the protection provided by it. The low level RF (LLRF) was not considered as an option as a shutoff device due to the potential for oscillation in the system. The LLRF is will be used to shut the Klystron down quickly. The x-rays from the electron gun and the 3.5 MeV beam (and the 25 MeV beam) will be stopped by these critical devices.

(CK-ERL-FY2006-490) The existing 13.8 kV contactor will be used as a reachback for the 4160V contactors. The committee will reconsider this device as a reachback if an engineering review determines it is not suitable. Normally we do not reachback to 13.8 kV, but since this contactor was available from MPS operations in the past it was decided to utilize it.

(CK-ERL-FY2006-491) The critical devices for the five-cell cavity will be two 480V contactors. This will terminate the x-rays from the five-cell cavity (it will also prevent acceleration of the 3.5 MeV beam).

(CK-ERL-FY2006-492) The will be no reachback device for the two 480V contactors. The access control system will generate the local radiation emanate alarms if it detects a reachback condition and send alarms to the CAS and MCR.

The present approved scheme does not require the laser in the interlock system for radiation protection. It is not clear if the laser will have interlocks for access into the ERL area. The configuration has not been determined.

Interlock Testing

(CK-ERL-FY2006-493) It needs to be determined if the interlocks for ERL will require semi-annual or annual testing.

Beam Fault Protection

The committee was asked to provide guidelines on the acceptable fault levels that chipmunks could provide protection. The committee would like the design to have one

chipmunk detect faults up to 1 rem/hr. Two chipmunks must interlock for faults between 1 to 10 rem/hr.

The committee was asked to consider if other devices could be used to supplement the chipmunks for high fault levels. Attachment 3 provides a brief discussion of several schemes under consideration. Attachments 4 and 5 discuss the potential fault levels outside the shielding under various conditions. Shielding changes and shielding near the beam pipe are under consideration. If additional devices can be used to supplement the chipmunks the shielding design will be impacted.

P. Cameron made a presentation (see attachment 6) on detecting losses using beam current transformers in differential mode. The beam current transformers would have a null circuit and keep alive circuits. To compensate for thermal drifts, spurious magnetic fields, and gain/linearity the beam may need to be turned off every 1-5 minutes to renull. With this scheme beam losses approaching 0.1 microAmp could be detected. For a 50 mA 25 MeV beam a loss of 50 microAmps represents a factor of 50 below the 50 kW maximum beam loss limit. It was considered quite easy to detect this level of loss with the current transformers. Several members were uneasy with the idea of using the current transformers. Since time was up the meeting was adjourned. Discussion will continue in a meeting in 1-2 weeks on the current transformers and other options to limit beam losses.

Attachments (File copy Only):

1. E-mail, D. Beavis to RSC and attachments, August 8, 2006
2. E-mail, D. Beavis to RSC, August 8, 2006.
3. D. Beavis, “Comments for the RSC Meeting of August 10, 2006 on ERL”, August 8,2006
4. K. Yip, “ Radiation Estimates Related to the Energy Recovery Linac Facility (ERL)”, March 22, 2006
5. D. Beavis, “Simple Estimates for ERL Radiation”, August 1, 2006 and updated August 9, 2006.
6. P. Cameron, “Differential Current Measurement for Personnel Protection”, PowerPoint presentation, August 10, 2006.

CC:

RSC minutes file
RSC ERL file
RSC
Attendees