C-AD
Radiation
Safety
Committee

Issued: April 16, 2004

Minutes of Radiation Safety Committee of April 1, 2004

Proposed Increase of the A20 transformer limit for RHIC injection

Present: D. Beavis, A. Etkin, R. Karol, P. Bergh, L. Ahrens, Michelle Wilinski, and J.W. Glenn

The primary purpose of the A20 transformer interlock is to limit potential dose to personnel who might be over the RHIC injections arcs at Thompson Road during a maximum credible beam fault of polarized protons. The limit of $6*10^{11}$ protons per AGS cycle was established when Thompson Road was an uncontrolled area. Shortly after the A20 limit was established the area over the injections arcs was changed to a Controlled Area when RHIC can be injected with either ions or proton beams.

Polarized protons have been injected into RHIC using single bunches. Injection with six bunches may be attempted this year. With the potential of $2*10^{11}$ protons per bunch a limit of at least $1.2*10^{12}$ protons per AGS cycle has been requested.

The committee approved an upper limit of $2.5*10^{12}$ protons per AGS cycle.

Discussion

The potential dose on Thompson Road based on fault studies is 1.5 micro-rem per 10^{10} protons. Routine operation of an arc would have 6 bunches per AGS cycle with $2*10^{11}$ protons per bunch with a total of 20 cycles injected (120 bunches in a ring in RHIC). The dose from such a fault would be 3.6 mrem. This is a Controlled Area. The most likely area where a fault like this could occur is the upstream portion of the arcs, which are protected by chipmunks. The fault in this area would most likely be stopped in 1-2 cycles, thus lowering the dose to 0.4 mrem. Under routine operations the maximum credible fault produces acceptable dose levels.

It is worthwhile to consider less credible (probably non-credible) faults, which might occur under non-routine conditions. The polarized proton source typically can provide a maximum bunch intensity of less than $1.5*10^{12}$ protons. Assume that the A20 transformer is bypassed or fails and the operators mistakenly attempt to fill RHIC with 120 bunches with the maximum achievable intensity. The dose at Thompson road would be 27 mrem. Most likely the chipmunks would terminate such a fault in 1-2 AGS cycles.

A continuous loss of routine intensity of $1.2*10^{12}$ protons per AGS cycle with one cycle every 5 seconds could produce fault levels of 129 mrem/hr. Such a fault is prevented by operator procedures and ALARMS (via the program BLAM) when injection losses are too high. In addition the chipmunks would most likely terminate the fault in 1-2 AGS cycles.

The maximum fault with the polarized proton source would be to continuously dump the beam in the arc. This could create potential levels of 972 mrem/hr. Such a fault would require the following simultaneous fault conditions to occur:

1) Failure of operators to follow procedures.
2) Failure of the A20 transformer.
3) Failure of the BLAM alarms or the operators to respond to them.
4) Failure of the chipmunks to terminate the fault.

The guideline 9.1.11a says that a hardwired device or equivalent is needed to protect for such faults. The systems in place meet or exceed this requirement.

There may be limitations in the electronics that may prevent an interlock level corresponding to $2.5*10^{12}$ protons per cycle from being established. It is expected that a level above $1.2*10^{12}$ protons per cycle can easily be established and therefore satisfy the operating request.

The A20 transformer interlock was not established to limit faults in the RHIC ring. However, since it can limit the bunch intensity, the potential for faults levels on the RHIC berm were discussed. The only portion of the RHIC berm, which is uncontrolled, is where Railroad Ave. crosses over the ring. The dose due to faults at injection energy is 1.5 micro-rem per 10^{10} protons and 7 times higher at 250 GeV/c. At injection energy the dose in a fault would be 3.6 mrem (120 bunches of $2*10^{11}$ protons). At full energy the dose would be 25 mrem, although a localized full beam fault in the sector under Railroad Ave. is not expected to be achievable.

The program BLAM monitors RHIC for integrated beam losses and ALARMS operators if the losses are too high. It was recommended that an action item be formed for the BLAM program to be reviewed for any potential gaps in its monitoring capability.
(ACT-1-RHIC-Lief Ahrens-due9/1/04)

CC:

RSC
Present
RSC Minutes file
RSC RHIC file