

C-AD

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Radiation

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Minutes of Radiation Safety Committee of July 3, 2001

Committee

Light Ions from the Tandem to C-A Complex

Present: A. Aronson, D. Beavis, C. Carlson, I-H. Chiang, A. Etkin, H. Kahnhauser,
E. Lessard, W. MacKay, T. Roser, P. Theiberger, and M. Zarcone

The meeting was held to discuss issues related to transporting light ions from the Tandem through the transfer line to the Booster and subsequent use at RHIC or other C-A facilities. Deuterons may be of interest for the RHIC program this fall. Deuterons beams can generate the highest dose rates at the Tandem and along the transport line and therefore establish the most stringent constraints on the protection system.

The process to obtain approval for light ions in the transfer line is expected to take almost six months. It is therefore expected that the necessary reviews by the committee must be completed by the end of July for deuterons to be available at the end of the year.

P. Theiberger presented an overview of the proposed operating mode and potential radiation levels (see attachment 1). MP6 will be used to deliver deuterons to the transfer line and the booster. The deuterons would be stored at injection energy in RHIC for approximately five minutes while the transfer line rigidity is changed for the Au beam. MP7 would be used to deliver the Au beam.

The potential dose levels that can be created are very energy dependent. Limiting the energy of the light ion beams in the transport line can greatly reduce the maximum credible dose that could be created. P. Theiberger presented the energy dependence of the radiation levels created by stopping a deuteron beam (see attachment 1). Measurements were made at angles of 30 and 90 degrees with energies ranging from 6 MeV to 12 MeV and scaled to 100 micro-Amps DC beam. The dose rate (at 1 foot) for 12 MeV and 30 degrees was 2500 rem/hr.

The beam transmission through the tandem decreases with energy. It is proposed that deuterons of energy between 10-12 MeV be used. Interlocks can be applied to the bends in the bypass line for MP6 which limit the maximum energy of the deuteron beam to 12 MeV. The CEE will be requested to examine if the RIS units can be used on the power supplies for this purpose. These are hardwired failsafe devices. Another appropriate device/method will be proposed if the RIS units can not be used. **(CK-Tandem-deutrons-fy2002-241)**.

The tandems can produce deuteron beam energies up to 30 MeV. The areas in the tandem vault and target rooms must be evaluated for this energy or the appropriate controls presented which may provide additional limits to the beam energy. This review must also include the maximum expected beam current that the tandems can sustain. This is anticipated to be a few micro-amps. The tandem can produce 100 micro-amps of beam for a brief time. Adjacent areas must also be reviewed that they stay in compliance.

Review of tandem and adjacent areas for deuteron beams. **(CK-tandem-deuterons-fy2002-242)**

The interlocks for the tandem areas are single layer interlocks. Routine operations must not produce levels greater than 50 rem in an hour for these areas, or the interlocks must be upgraded. This should be part of the deuteron review. **(CK-Tandem-deuteron-Fy2002-243)**

The beam stops in TTB have a rating of 300 watts. The beam stops need to be reviewed for light ions. The CME will be asked to examine the potential failure of the stops and their power rating. **(CK-TTB-deuterons-fy2002-244)**

The area over the transfer line from the tandem to building 908 is uncontrolled. After building 908, the transfer line is inside the AGS berm fence, which is a radiation area. Most of the transfer line has a minimum soil thickness of 3 feet. The soil thickness should be measured. **(CK-TTB-deuterons-fy2002-245)**

A 75-100 foot section immediately before building 908 has less than 3 feet of soil coverage. Rather than add soil, the committee recommends that this area be posted as a controlled area during light ion operations. **(CK-TTB-deuterons-fy2002-246)**

There are two operations modes for the transfer line. The first is tuning with low intensity DC beams. The typical beam intensity would be 10 nano-amps, which corresponds to 2.2×10^{14} deuterons per hour. A maximum DC beam of 1 micro-amp would correspond to 2.2×10^{16} deuterons per hour. Pulsed beams for injecting the booster would be 100 micro-amps for a duration of 500 microseconds and 5 pulses every 2.5 seconds. This corresponds to 2.2×10^{15} deuterons per hour. Typically the pulsed mode would not have a duration of an hour. A. Stevens has done an MCNPX calculation for a 12 MeV deuteron beam striking an iron target in the tunnel (see attachment 2). A 100% beam fault in the tunnel would produce the dose rates below on the berm, assuming 3 feet of soil:

Deuterons per hour	mrem/hr on berm
2.2×10^{14}	0.45
2.2×10^{15}	4.5
2.2×10^{16}	45.

The MCNPX calculations give a dose rate at 1 foot from the source of 450 mrem/hr in the forward direction for the pulsed beam operation of 2.2×10^{15} deuterons per hour. This suggests that the single layer of interlocks for the transfer line is sufficient for routine operations. Calculations were also done for a tungsten target. In this case the dose rates with 3 feet of soil

are a factor of 4 lower than the iron target calculation. The calculations should be reviewed and scaled for possible maximum credible fault levels. **(CK-TTB-deuterons-FY2002-247).**

Adjacent areas and weak points such as power supply houses, ventilation shafts, etc. should be checked for compliance. **(CK-TTB-FY2002-deuterons-248)**

The AGS low intensity mode must be disabled or reviewed for the light ion beams. **(CK-TTB-deuteron-fy2002-249)**

The areas in which the light ion will be delivered must be reviewed. **(CK-TTB-deuterons-fy2002-250)**

Attachments:

- 1) P. Thieberger presentation (file copy)
- 2) A. Stevens MCNPX calculations (attached)

cc: Tandem file
RSC
Present
RSC info