C-AD

Radiation Safety Committee

Issued: August 12, 2014

Minutes of RSC Subcommittee of August 11, 2014

Subject: Design of a Soil Cap for Booster E7 Proton Scrapping

Present: D. Beavis, E.T. Lessard, C. Gardner, K. Yip, C. Schaefer, D. Phillips, A. Pendzick and H. Huang

The committee reviewed calculations for a possible soil cap over E7 in the Booster. Polarized proton operations from two years ago demonstrated that the physics program would benefit[1] if the vertical scrapping was done at E7 rather than under the B6 beam dump cap. Removable soil samples placed in the Booster provided evidence that if scrapping is conducted at E7 for an entire run that the BNL action limit for tritium would be exceeded. The preliminary estimate is that the soil cap would have dimensions of 40 feet wide and 70 feet long when projected onto a horizontal plane. The schedule for the cap is very tight and may not be doable. The Booster starts up in Sept. for the NSRL run. It would be a risk to have a contractor on the berm with Booster operations but with careful planning it may be possible. The cap will likely have a cost exceeding $100k. There are proton programs that require the cap off and on for the next 7 years. After that the demands for scrapping is expected to be smaller. Temporary capping means should be considered to meet the immediate schedule including a phased approach for the cap.

K. Yip provided MCNPX calculations[2] on the contours of neutron fluence that were conducted for B6 beam dump and D6 extraction septum. These calculations were conducted several years ago by a student a working under his direction. The calculations were conducted to provide an estimate of the decommissioning efforts for the machine. Kin felt that these two models provided an envelope for the issue of soil activation for vertical scrapping at E7. The models are very detailed but do not have magnetic fields. Although the models are very details they do not provide an accurate description of the actual E7 area. Most likely they provide good guidance in determining the width of the soil cap but not the length.

In discussion and in the presentation it was noted that the soil sample and the model (for B6 were different by a factor of 26. The conversion of the MCNPX results soil activation is done using data from the U line and comparing CASIM star densities to the activation products. This is the

[1] No quantitative evidence was provide but this is not within the scope of the committee.
[2] K. Yip, Aug 11, 2014, Powerpoint file

basis for the conversion numbers in the SBMS. Since CASIM overestimates the production of radiation in the forward direct there is some possibility that these conversion factors could require adjustment. In the near transverse direction CASIM was more reasonable in the radiation estimates and much too low in the backward direction. Whether this contributes to differences in comparison of the soil sample to the Monte Carlo results is unclear but the ration of ^{22}Na to ^{3}H should be less sensitive than the absolute concentration.

C. Gardner showed the profile of a Booster magnet. There is less steel on the mid-plane than vertically. No comparison of the material in the two models to the actual booster magnets was provided during the meeting.

A comparison of the soil samples near the B6 dump to the model was also not provided.

The location of the soil sample relative to E7 scrapping location was not provided. This may be important in closer comparison of the model to the soil sample results.

It was noted that the reducing the length would be more a benefit than the width due to encroachment on cable trays near Building 914. Encroachment with cables trays on the inside perimeter of the berm appears at the present not to be an issue since the soil cap at the B6 dump just clear the cable trays and was designed[3] for higher losses. When the berm plant growth is reduced the engineers will examine the details of potential interferences more closely.

The committee recommends the following:

With the limited time remaining[4] before the proton run it is hoped that personnel will promptly address the actions listed below.

The Accelerator Division[5] may want to consider reducing the 24/7 scrapping that is conducted at E7. It was unclear to some committee members why this has to be done continuously. A reduction in the number of hours when scrapping occurs at E7 could eliminate the need for the cap.

That the number of protons lost at E7 with the soil sample be extracted more carefully than the present assumption of $2*10^{11}$ protons every 3.9 seconds. Kin noted that the based on that soil sample result that the activation scaled to a full run of 16 to 20 weeks would only be 20-30% above the BNL action limit for tritium. It is important to establish a more realistic limit to the number of protons lost so that more temporary means of protecting the ground water can be considered. This protons lost during should be produced on a short time scale so that the engineering choices can be made. If the model numbers are used with the SBMS method then the concentrations will exceed the BNL soil limit by a factor of 20 or more close to the loss point. At present the plan is to proceed as if a soil cap is need.

[3] The Booster dump was designed for $1*10^{20}$ protons at 2 GeV per year while 20 weeks of scrapping at E7 is for $2*10^{18}$ 1 GeV protons per year.
[4] Due to the limited time all actions have been placed in the RSC check-off list database rather than ATS.
[5] This is outside the scope of the RSC but could be an important consideration.

(Ck-Aug 25, 2014-Booster-Huang&Gardner-918) Provide a more accurate estimate of protons lost at E7.

A brief statement of the details on the number of protons to be scrapped at E7 for upcoming proton operations needs to be provided for scaling the soil activation results. This should include reasonable estimates of duty cycle and upgrades to the potential proton program. **(Ck-Aug 25, 2014-Booster-Huang&Gardner-919)**

Provide documentation of the soil sample location. **(Ck-Aug 25, 2014-Booster-Huang&Yip-920)**

The RSC or subcommittee must meet again to discuss the appropriate margin of safety to apply to that number folding in issues such as accuracy of the models and to further review the model results. **(Ck-Sept. 5, 2014-Booster-Yip and Beavis-921)**

The scrapping on the magnet upper face of a dipole will be simulated by K. Yip by modifying the existing models used for the B6 and D6 areas. The results will be used to determine the width of the final cap design and the back extent of the shield. **(Ck-Sept. 5, 2014-Booster-Yip&Beavis-922)**

The extent of the cap in the forward direction would require substantial rework of the MCNPX model. The plan presented was to follow the design scheme of the B6 dump cap and extend the cap until the tunnel turns sufficiently away from the forward neutrons such that they no longer strike the tunnel wall. It is important to note that the B6 cap was designed for 100 times more losses than planned at E7. It is probably excessive to extend the cap as far as was done for the B6 beam dump. It is noted that the calculations conducted for the B6 dump soil cap design used CASIM which overestimated the fluence of high energy neutrons in the forward direction. The engineers noted that the length of the cap has substantial impact on the cost as cable tray supports are approached. In addition, drainage of building 914 must be considered to ensure that it does not create a source of soil flushing under the soil cap.

(Ck-Sept. 5, 2014-Booster-Phillips& Pendzick-923) Determine if drainage issues from building 914 impact the soil cap design.
(Ck-Sept. 5, 2014-Booster-Yip&Beavis-924) Review the forward extent of the soil cap.

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Attendees