Dose Measurements at SIS18 and connected experimental halls TR, EX, TH

T. Radon[1], K. Beverung[1], R. Fleissner[1], P. Freml[1], P. Kewes[1], C. Pöppe[1], and J. Sauer[1]

[1]GSI, Darmstadt, Germany

High Current N-Beamtime at SIS

Similar to the situation in 2011 the beam time in 2014 was dominated by high current 1.9 GeV/u N-beams which were accelerated at SIS18 during the second beam time block. The beam was extracted with 6E+10 particles per second at maximum and guided to the pion production target. Due to distinct beam losses in SIS18 and grave losses in the connected high current beam transfer line at that time consequently pronounced activations of the beam line components occurred. Besides the expected activation of the extraction area in the millisievert-per-hour regime a further salient hot spot evolved at the first quadrupole after the electromagnetic septum. A residual dose rate of 1.5 mSv/h was measured at the end of the beam time block, 6 weeks after the end of the high current N-beam time. This residual dose rate was four times higher than previously ever measured at this position. Noticeable activations of several hundreds of microsieverts-per-hour at a couple of positions of the high current transfer beam line especially in the TH2 and TH3 areas showed up still weeks after the end of the runs. The maximum of the residual dose rates was found at the dipole TH3MU1 and the connected diagnosis chamber. Still in January 2015 60 µSv/h have been measured at that position.

The integrated doses during the high current N-beam time which lasted for about 40 days including several interruptions comprised more than 90% of the total annular dose at certain stationary survey measurement points in the halls TR and especially EX, see Fig. 1.

In the course of the N-beam time an explicit activation of air has been detected for the first time at GSI. Peak activity concentrations of more than 1000 Bq/m^3 for Ar-41 outside controlled areas were measured for a few days. For a later FAIR operation this beam time has been a realistic test case. Planned measures based on Monte Carlo calculations for the future sealing of radiation protection areas of accelerators and experimental areas with subsequent cooling lines to vent stacks could thus be validated.

Prior to another measurement campaign in 2017 or later of such high-current beam-times for the production of pions several precautions minimizing prompt dose-rate, air activation and activation of beam components have to be undertaken. Local shielding of the top of the dipole magnet TH3MU1 and a tracking target with at least 1m of concrete-equivalent including concrete sidewalls of certain strength are appropriate measures as well as enlarging the (vertical) gap-width i.e. the beam tube at few components. Finally the top shielding of the pion production target itself would need another layer (0.8m) of concrete slabs.

References

[1] T. Radon, et al. GSI-Report 2011-1 (2011) p. 352.

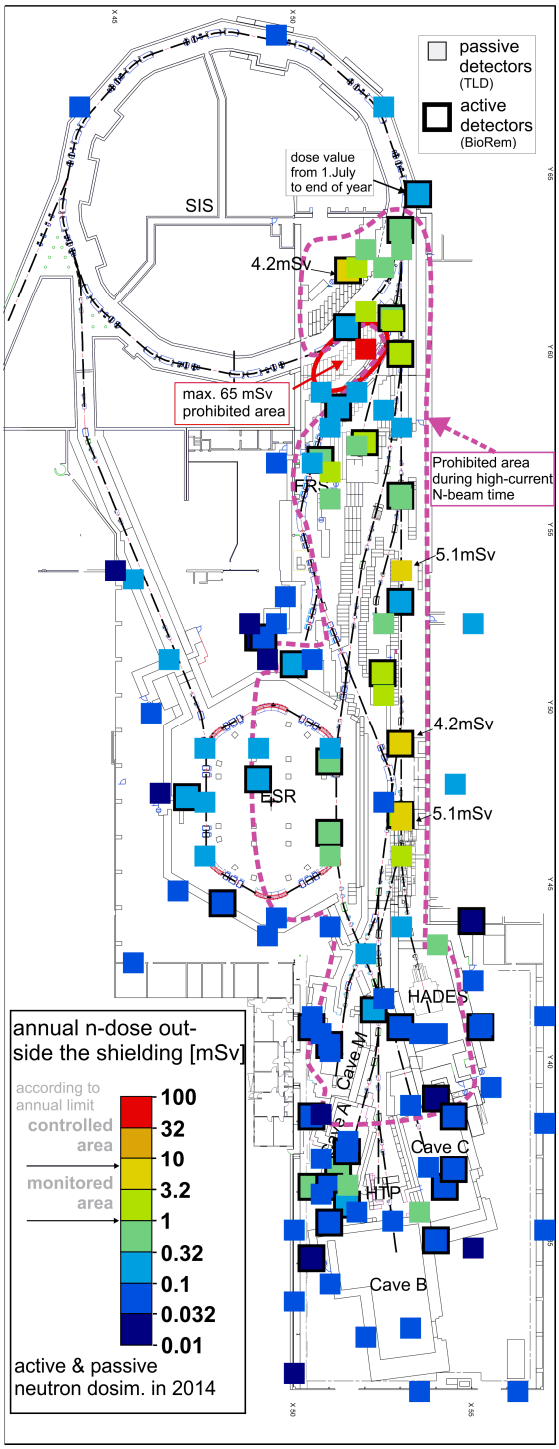

Figure 2: Map of the experimental areas connected to SIS18. Measurement positions of controlled areas are shown with doses recorded by active dosimeters (larger squares with frame) and passive detector (smaller squares).