Radiation protection update for the FAIR APPA building

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In 2011 the FAIR [1] application for construction approval was submitted to the radiation protection (RP) authorities based on -at that time- actual construction plans. In May 2014 the 11th and final part of the application was approved. However, since 2011 these plans underwent a series of changes due to ascertainment of additional needs by e.g. the scientific users, fire protection authorities or just the increasing grade of detail in the evolving FAIR project. These changes have to be reported to the RP authorities as an update of the 2011 application, because they might affect -to some grade- the radiation protection layout. This update-process requires a close monitoring and counseling of the necessary planning steps by the resident radiation protection at GSI, which is mandated to supervise all FAIR RP concerns.

In a first step, the needs of all involved parties are acquired by the RP coordination team involving the architectural layout, requirements of the scientific user and of course the existing RP layout. The new layout is then tested by Monte Carlo calculations deploying FLUKA [2,3] following the basic principle that the new layout has to perform equally or better concerning RP needs. This maxim is laid out to achieve a smooth approval procedure of the updated construction application. These updates range from minor adjustment of shielding walls or niches therein to an entire new wall layout of a whole building like the APPA building “G50”. The original layout of the APPA cave is based on a double concrete wall design, where in-between the walls soil layers were used to improve the shielding effect (see Fig.1).

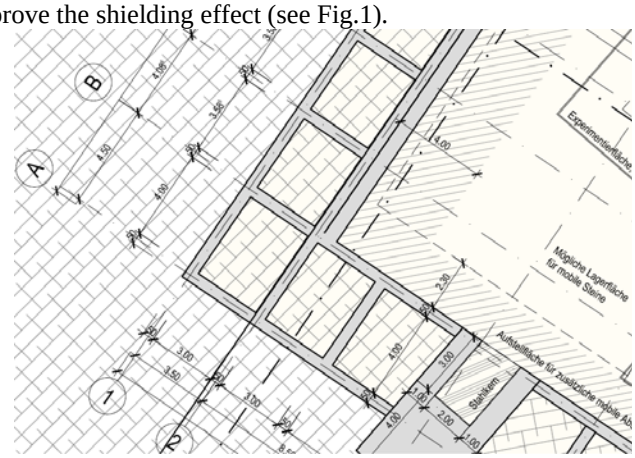

Figure 1: 2011 layout of south-east part of the building G50 with enclosed soil packs on the outside wall.

This rather complicated comb-structure was replaced by a construction with only one concrete layer for the walls, whereby the thickness of the wall was adjusted to fit both requirements: the shielding effect and the limitation of radioactive activation of the soil outside the cave. The effectiveness of the new layout was verified by means of FLUKA shielding calculations [1, 2] simulating a maximum possible beam loss with the U-238 beam with 2GeV/u and 1E10 ions/sec with beam interactions in a target (50%) and the remaining beam depositions in a dump (see Fig. 2). The radiation fields are substantially and sufficiently lowered within the concrete walls. Further adaptions are introduced for the roof shielding in the cave and for the access maze of the cave.

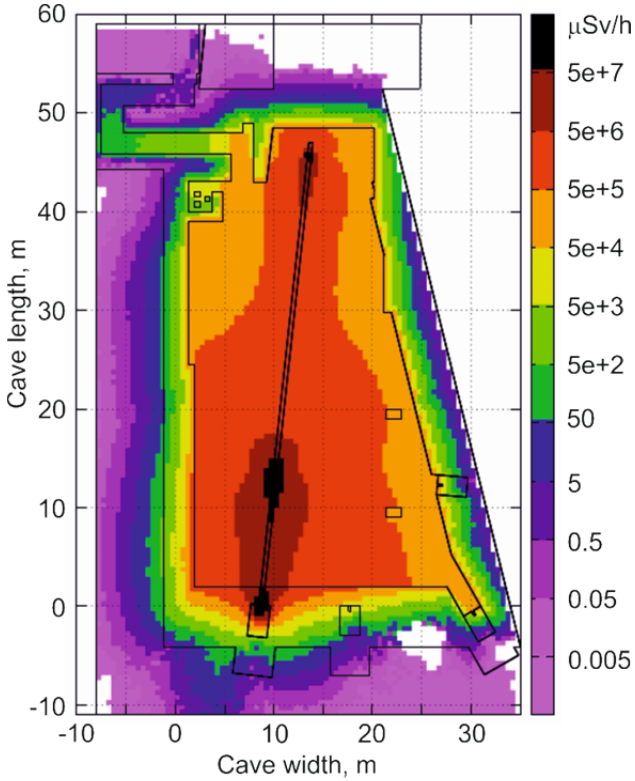

Figure 2: FLUKA calculation of new layout with solid-concrete walls. Dose levels in the surrounding soil (left and bottom) and at the end of the labyrinth (on the top left) are sufficiently low.

References

[1] FAIR Baseline Technical Report, Editors H. H. Gutbrod (Editor in Chief), I. Augustin, H. Eickhoff, K.-D. Groß, W. F. Henning, D. Krämer, G. Walter, September 2006
[2] T.T. Böhlen, F. Cerutti, M.P.W. Chin, A. Fassò, A. Ferrari, P.G. Ortega, A. Mairani, P.R. Sala, G. Smirnov and V. Vlachoudis, “The FLUKA Code: Developments and Challenges for High Energy and Medical Applications”, Nuclear Data Sheets 120, 2014, 211-214
[3] A. Ferrari, P.R. Sala, A. Fasso`, and J. Ranft, "FLUKA: a multi-particle transport code”, CERN-2005-10, 2005, INFN/TC_05/11, SLAC-R-773

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