Contribution ID: **45** Type: **not specified**

The EURISOL Multi-MW Target Unit: Radiological protection and radiation safety issues

Thursday, June 3, 2010 12:10 PM (20 minutes)

The research with radioactive beams has strengthened the link between technical developments and physics output. The study of radioactive beams allows us to follow the evolution of nuclear structure over extended regions in the nuclear chart. Two different ways of producing radioactive beams, in-flight separation and the ISOL approach, can be combined with different post-processing of the radioactive nuclei. In Europe, the recommendation is to construct separate facilities built on these two complementary production schemes. Immediate priority is given to the in-flight project FAIR, where first experiments are planned for 2012. Highest priority for further projects is given to the next-generation ISOL facility EURISOL, which can be constructed in the next decade. An intense R&D programme is being carried out to bridge the technological gap between present day facilities and EURISOL. It is recognized that one needs to proceed via several intermediate stage projects, one of them being HIE-ISOLDE and others including SPIRAL2 at GANIL. Outside Europe several projects also exist. Funding is already secured for the upgrade of the RI Beam Science Laboratory at RIKEN and for ISAC2 at TRIUMF , and in the USA a large community around the FRIB project is working towards construction of a new facility.

The EURISOL (The EURopean Isotope Separation On-Line Radioactive Ion Beam) facility which detailed design has been achieved in 2009, aims at producing high intensity (100-1000 times higher than currently operating facilities) radioactive ion beams with energies up to 150 MeV/u. Such characteristics will be achieved due to the high power (Multi Mega Watt) delivered by a proton beam of energies in the 1-2 GeV range and intensities up to 4 mA in a high-density spallation target (liquid mercury, commonly referred to as the neutron converter). As a result of the spallation reactions induced by the proton beams in the converter, very high neutron fluxes (in excess of 1015 n cm-2 s-1) are produced to induced fission in surrounding targets containing fissile materials (Uranium). The produced fission fragments are then extracted, accelerated and mass-separated and delivered to the experimental areas where measurements are to be performed.

As a result of the high-intensity proton beam, of the high-power delivered to the converter (spallation target) and of the very high-neutron fluxes generated by spallation reactions, the Target Unit of the EURISOL facility is a critical component of the facility. The associated radiation safety and radiological protection aspects are extremely important and very complex. In this paper, the Monte Carlo simulations of the neutronics, dose-rate and activation of the several components of the EURISOL facility are detailed, in its MAFF configuration which allows an easier manipulation, repair and maintenance of the fission targets. The extremely high levels of the material activation (up to 1012 Bq g-1 in some cases) and dose rates (dose-equivalent ˜106 Sv h-1) could be a show stopper for the operation of the facility. Appropriate radiation shielding need to be designed and implemented in order to assure the safe confinement of the radiation inside the facility during operation.
The results reported in this study were obtained using the state-of-the-art Monte Carlo codes MCNPX and FLUKA. Analysis of the activation of the structural materials is performed and discussed.

Acknowledgements
We acknowledge the financial support of the European Community under the FP6 Research Infrastructure Action Structuring the European Research Area EURISOL DS Project Contract No. 515768 RIDS. The EC is not liable for any use that may be made of the information contained herein. Part of the work has also been supported by the Portuguese Foundation for the Science and Technology (FCT) in the framework of the projects CERN/FP/83586/2008 and POCI/FP/81951/2007.

Primary authors: Mr LUÍS, Raul (Instituto Tecnologico e Nuclear (ITN)); Mr ROMANETS, Yuriy (Instituto Superior Tecnico (IST))

Co-authors: Dr KHAROUA, Cyril (CERN); Dr ENE, Daniela (CEA); Dr NEGOITA, Florin (NIPNE); Dr

GONCALVES, Isabel (ITN); Dr DAVID, Jeane-Christophe (CEA); Dr BERMUDEZB, Judilka (INFN-LNL); Dr TECCHIO, Luigi (INFN-LNL); Dr BARBUI, M (INFN-LNL); Dr ALYAKRINSKIY, O (INFN-LNL); Dr VAZ, Pedro (ITN); Dr ROCCA, Roberto (CERN); Dr KADI, Yacine (CERN)

Presenter: Mr ROMANETS, Yuriy (Instituto Superior Tecnico (IST))

Session Classification: Session 2 - Induced radioactivity

Track Classification: Induced radioactivity