Work Package 5

Text taken from "description of work" (Annex 1 of the proposal)

The SLHC project entails a tenfold increase of luminosity (and therefore collision rate) of the particle beams in the interaction points. In the SLHC experiments, scattered radiation is proportional to the collision rate. An increase in activation levels of the experiment and its surroundings comparable to the luminosity increase has to be anticipated. This has technical repercussions calling for a tight integration of the accelerator and the S-ATLAS and CMS2 experiments with the aim of maximising luminosity while keeping radiation damage at a minimum. The luminosity increase required for the SLHC will be obtained by two complementary ways: a better focusing of the beam in the interaction points and an increase of the beam intensity. The latter will lead to higher beam losses in the accelerators of the injector chain and the SLHC itself, with higher activation of structural material, of ventilated air and cooling water and related potential radiological impact on personnel and the environment.

In view of the high luminosity, it will be crucial for the design of the SLHC to identify all critical issues and design constraints, and to find, if possible, adequate solutions in the often conflicting requirements of machine and experiment performance on the one side, and component safety and radiation protection regulation on the other. The results to be obtained will be indispensable when assessing the feasibility of design and construction for both the accelerator and the experiments in terms of radiation protection constraints and identifying the needs for safety approval procedures as well as the impact of safety issues on the final costs.

Collaborative efforts must be established in order to reach an optimum between the design of accelerator and experiments and the tight regulatory requirements for radiation protection to be applied during their entire lifecycle including operation, maintenance and repair work of SLHC with its injector chain and of the experiments, eventual dismantling of the facilities, and the management of future radioactive waste.

This goal necessitates an iterative process of optimizing accelerator and experiment design and future operation in view of radiation protection and safety constraints. It will bring together experts from all relevant fields and different laboratories and will require effective coordination and exchange of information and data, in particular with other work packages within SLHC-PP. The involvement of all stakeholders from the start will ensure that essential safety aspects concerning radiation protection and environmental issues are taken into account as early as possible. The results and conclusions of this optimization process concerning radiation protection will be documented in reports which will be used to evaluate the compatibility of the proposed design with safety standards and radiation protection regulation.

Objectives

- identification of crucial radiation protection issues in the accelerator and the experiments; identification of critical areas (in terms of ambient dose equivalent rate) for operation and maintenance of the accelerators and experiments.

- assessment of radiological impact on personnel and environment for the entire accelerator chain as a function of beam intensity increase and for different design options for the integration of focusing and experiment assemblies
- investigation of operative procedures for interventions in high-intensity accelerator/experiment regions for maintenance and repair with a view to minimize the radiological impact.
- investigation of activation of different structural and detector materials in order to estimate future radioactive waste and the cost of its future characterisation and elimination.

Description of work

Task 5.1 Experiment Radiation & Activation: simulation calculations for activation and radiation in the detectors and adjacent regions; validation of the simulations with measurements at LHC; studies of consequences for different accelerator focusing options, investigation of protection measures such as shielding, and of design options aiming at reducing radiation exposures during maintenance and repair intervention (CERN, GSI, USFD, CTU)

Task 5.2 Accelerator Radiation & Activation: simulation calculations for activation and radiation in critical regions of the SLHC and its injectors; evaluation of doses to materials and equipment with provisions to minimize the consequences for equipment lifetime and reliability of beam operation, thereby also minimizing the frequency of maintenance and other interventions (CERN, GSI)

Task 5.3 Impact Study: based on the radiation and activation studies, assessment of dose rates in areas of the SLHC accessible during operation, as well as of the exposure of the public and the environment due to effluents (air, water); estimation of dose rates to personnel from activated equipment in the accelerators during access for maintenance and repair intervention; estimation of amounts of radioactive waste and cost of conditioning and disposal; study of possibilities to minimize waste (CERN, PSI, USFD, CTU).