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OCCUPATIONAL HEALTH & SAFETY AND ENVIRONMENTAL PROTECTION UNIT

RADIATION PROTECTION GROUP

CERN RADIATION PROTECTION CONDITIONS FOR INFN WORKERS

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1. INTRODUCTION

Following recent changes in Italian regulations (implementation of Directive Euratom 2013/59) CERN has been asked to provide INFN institute with details on radiation protection of INFN personnel like the description of the installations, expected annual committed dose, dosimetry techniques, training provided…

This document aims to fulfill this request with a general description that could cover all radiological conditions possibly met by INFN workers on the different CERN sites.

2. CERN RADIATION PROTECTION CONSIDERATIONS

2.1. GENERAL INFORMATION

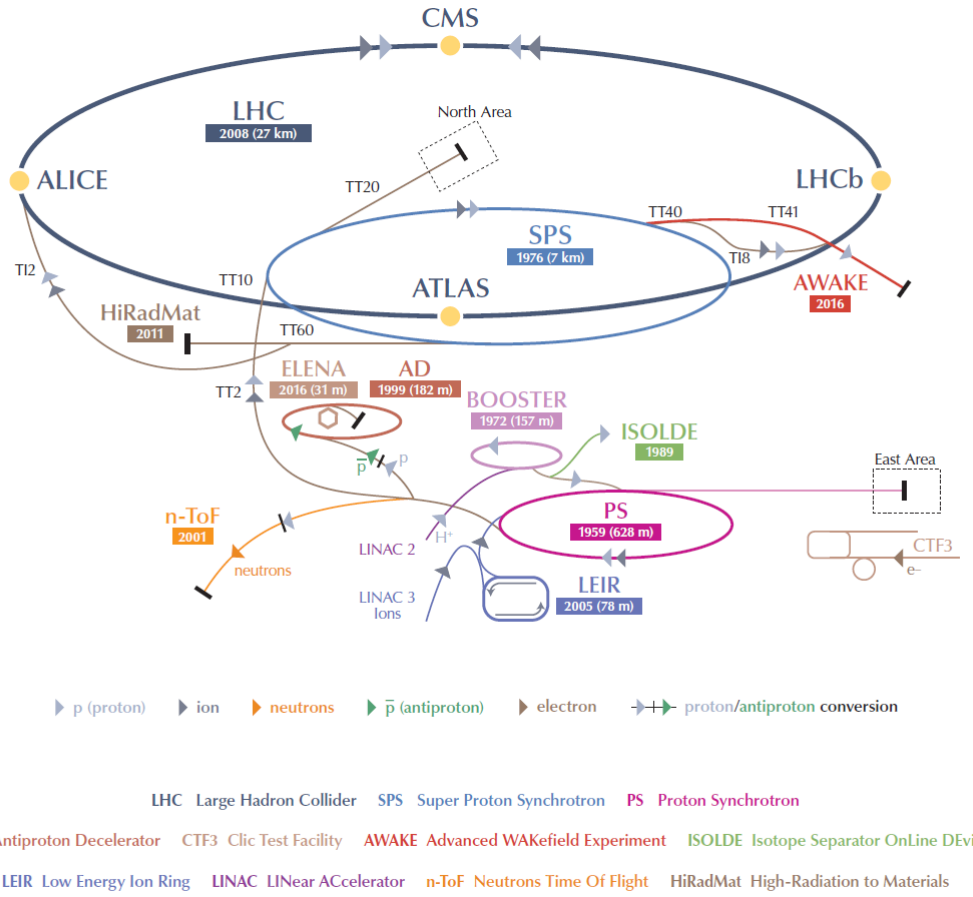
CERN, the European Organization for Nuclear Research, is an intergovernmental organization with over 20 Member States[1].

Its seat is in Geneva but its premises are located on both sides of the French-Swiss border (https://maps.web.cern.ch).

[1] http://home.cern/about/member-states

CERN's mission is to enable international collaboration in the field of high-energy particle physics research and to this end it designs, builds and operates particle accelerators and the associated experimental areas. At present more than 10 000 scientific users from research institutes all over the world are using CERN's installations for their experiments.

The accelerator complex at CERN is a succession of accelerators with increasingly higher energies. Each accelerator injects the beam into the next one, which takes over to bring the beam to an even higher energy. The flagship of this complex is the Large Hadron Collider (LHC) as presented below:



Further information is available on the CERN website: http://cern.ch

2.2. OPERATIONAL RADIATION PROTECTION

CERN is an accelerator complex with more than 50 km of accelerators tunnels, large underground and surface experimental areas comprising over 1000 radiologically classified areas on its different sites across the Swiss/French border.

During beam time (beam on) accelerator areas are closed to the workers and, therefore, there is no risk of direct exposition to the beams. The operation of particle physics experiments or incidental beam losses in near-surface accelerators might result in a mixed field exposure for workers (gamma and neutrons). To minimize this risk an online monitoring system based on ionization chambers will create radiation alarms in case pre-defined dose equivalent thresholds are exceeded. For some areas the alarm will also trigger interlock of the accelerators to stop them in case of an abnormal situation. During shutdowns (beam off), when working in experimental areas or accelerators facilities is possible, workers are mostly exposed to radiation from induced radioactivity: mainly gamma radiation due to activation of metallic or concrete materials.

CERN Safety Code F stipulates the basic Radiation Protection rules. The radiological risks that might be encountered in a certain area due to prompt and residual radiation are reflected by its radiological classification.

CERN regulations for radiological area classification

CERN Online tool for area classification: RAISIN

Some areas at CERN are presenting contamination risks. If a worker needs to work with unsealed sources or contaminated material, adapted Personal Protective Equipment (PPE) are provided by CERN RPO's depending on the situation.

All Radiation Workers are monitored with personal dosimeters (DIS) provided by the CERN dosimetry service. They are equipped with sensors for the detection of gamma radiation and, additionally, during accelerator operations, with neutron dosimeters. Moreover, if required, electronic dosimeters (DMC) and extremity dosimeters are also provided.

All works in Radiation Areas are subject to a "work permit". This work-permit is integrated into the overall system for work planning and authorization, called "IMPACT". It includes dose estimations, work procedures and allows on-line follow-up of operational doses measured by DMC dosimeters. All RP data are managed by CERN RPO's, company/institutes experts and CERN work supervisors. Doses can be viewed online anytime by workers involved in the activity to compare integrated doses with doses estimates.

The details about operational radiation protection actors and procedures at CERN can be found in this web page.

2.3. DOSIMETRY SYSTEMS AND DATA

Instrumentation:

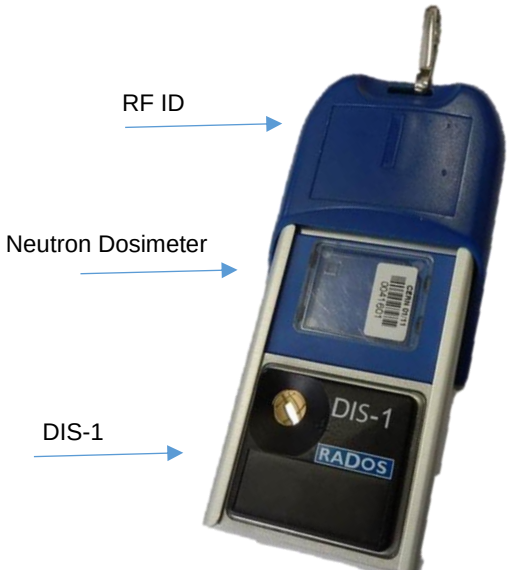
Individual dosimeter : DIS-1 from Miron : datasheet (minimum dose interval 1 uSv).

Operational dosimeter : DMC 2000 / DMC 3000 from Mirion: datasheet (minimum dose interval 1 uSv).

Extremity / Neutron dosimeter from PSI : website (detection limit for neutron or extremity dosimeters : 0.5 mSv – Swiss legal threshold)

The CERN dosimetry service is recognized by Swiss Federal Office for Public Health (FOPH) and accredited following ISO 17025:2017 by the Swiss Accreditation Service (Ref: STS 0650)

All Radiation workers have online access to their dose at any moment. All details about dosimeters and training can be found in the dosimetry service webpage: http://dosimetry.web.cern.ch/en



CERN Individual Dosimeter:

DIS-1 from Mirion

CERN Operational Dosimeter:

DMC 3000 from Mirion

2.4. CERN DOSE CONSTRAINTS

At CERN, Radiation Workers are classified either in professionally exposed worker of Category A (max 20 mSv/year effective dose) or B (max 6 mSv/year effective dose). In practice, most Radiation Workers are classified as category B.

CERN doses per dose interval over the last 5 years:

Dose interval (mSv)	Persons Concerned	Persons Concerned	Persons Concerned	Persons Concerned	Persons Concerned
years	2015	2016	2017	2018	2019
0.0	8704	8788	9034	9824	8462
0.1-0.9	1108	1003	1110	1260	1494
1.0-1.9	2	11	3	10	13
2.0-2.9	0	0	0	0	0
3.0-3.9	0	0	0	0	0
4.0-4.9	0	0	0	0	0
5.0-5.9	0	0	0	0	0
> 6.0	0	0	0	0	0
SUM PERS	9814	9802	10147	11094	9969

CERN annual collective dose depends on shut down and beam periods as more activities in Radiation Areas are carried out in accelerators during shut down periods. CERN applies an overall dose constraint for shutdown periods of 3 mSv effective dose per worker over 12 consecutive months. In addition, all work in Radiation Areas is optimized according to the ALARA principle and formalized in a dedicated procedure [ALARA].

2.5. TRAINING

All persons working on CERN sites are obliged to successfully complete a Radiation Protection Awareness training (computer-based). Moreover, before classification as Radiation Workers, personnel are obliged to successfully complete a Radiation Protection training consisting of different modules depending on the radiological risks that might be encountered:

- RP supervised areas (online training): mandatory to work in Supervised Radiation Areas.
- RP controlled area (1-day classroom training): mandatory to work in Controlled Radiation Areas.

Our training material is approved by the Swiss Confederation and is subject to confidentiality agreements with companies giving the lectures for CERN. Our current

classroom courses are given on an interactive display and comprise theoretical and practical (hands on) parts dedicated to CERN specificities.

All courses have a validity of 3 years. After 3 years an online refresher course must be taken for each course to keep the training validity and, thus, the dosimeter and the access rights to Radiation Areas.

CERN Learning Hub

All question related to CERN radiation protection can be addressed to: rp@cern.ch