

IBERINCO support to the Radiation Protection Group at CERN

V. Magro¹, C. Garrido¹, B. Lamela¹

¹Iberdrola Ingeniería Consultoría, Avda. de Burgos 8 B Madrid 28036 SPAIN
E-mail: vmlo@iberinco.com

Abstract. The European Organization for Nuclear Research (CERN), is an international organization of research that provides to physicist with particles accelerators to develop experiments and theories. The use of this accelerators constitutes a risk of exposure to ionising radiation for people and radiological effects on the environment. The CERN's Radiation Protection Group has between others the mission of preserve an exposure and radiological effects on the people and environment **As Low As Reasonably Achievable**. It is also very important they help in the interpretation and application of the general rules set out in the CERN's Radiation Safety Manual in order to resolve the often complexes and constantly changing problems encountered around the accelerators and at the experimental areas. IBERINCO has participated as part of the CERN's Radiation Protection Group in different tasks that have been developed during the 2003 annual shutdown. The main works carry out by IBERINCO staff consist on: Protection of Persons, Classification of Working Areas and Management of Radioactive Material.

1. Introduction.

CERN is the European Organization for Nuclear Research. It's main objective is to provide the physicists with the necessary tools (accelerators) to accelerate particles to almost the speed of light and detectors to make the particles visible. This allow physicist to develop experiments and theories.

The main research tools at CERN are particles beams and their use constitutes a risk of exposure to ionising radiation for people. The Organization's radiation protection policy stipulates that this exposure and the radiological effects on the environment shall be as low as reasonably achievable (ALARA).

The CERN Radiation Protection Group controls hazards connected with radiation and radioactivity, produced by the particles accelerators functioning, to ensure the safety of persons and facilities in this field, and to advise and assist all those working at CERN in protecting themselves against such hazards.

2. Radiation Protection in the Workplace.

2.1. CERN Singularities.

The Research Institute covers an area of a very big extension. On surface it is constituted by two main areas, one in France (Fig 1-Prévessin site), and the other one in Switzerland (Fig 2-Meyrin site). Under surface there are the accelerators facilities (Fig 3) where the ionising radiation are originated. On surface apart from the two main sites (Prévessin and Meyrin), there are different points of access to the accelerators which are also under surveillance.



FIG. 1: Meyrin site.

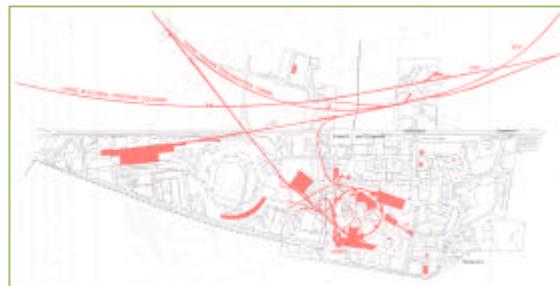


FIG. 2: Prevevssain site.

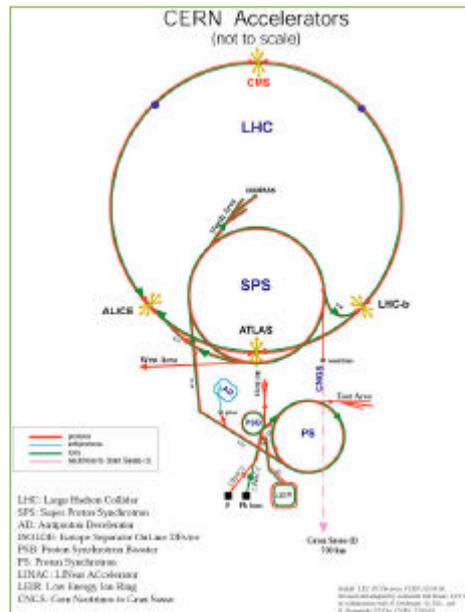


FIG. 3: Accelerators Facilities.

During a year different experiments with particles beams in different conditions are developed. Before those experiments are carry out the RP group is informed to advise about the risks and also to assist during the experiment if it is required to guarantee the protection against radiation in the work place.

Also it is important highlight that is during the annual shutdown, like in Nuclear Power Plants, when the main maintenance works and new experiments assembling are executed. A planning of the main tasks, where the Radiation Protection personnel is involved, is prepared before the works start. This allows to the Radiation Protection personnel to program the work in the better way.

2.2. IBERINCO participation

IBERINCO has collaborated during 2003 annual shutdown in the works developed by the Radiation Protection Group. This paper stand out those radiation Protection Group activities in which IBERINCO staff has participated.

2.1.1. Protection of Persons.

All people working in the presence of ionising radiation at CERN's, whether or not they are members of the personnel has to be controlled (monitored, etc.) by the RP group that informs of any possible exposure hazards and gives appropriate radiation protection instructions. All the exposures are monitored and recorded.

People exposed to Ionising Radiation are classified at CERN depending on the probability of receiving an annual dose of over 5 mSv. Is the RP Group responsibility to classify people in one of the below categories depending on: person's duties, his work place on the site, and any other factor which might affect his exposure. People working at CERN can be classified as:

1. Individually monitored persons:

- Persons that work regularly in controlled radiation areas or likely to receive an annual dose of over 5 mSv. These persons are categorised as ACT's (Aptes au Travail en zone Contrôlée).
- Persons that work regularly in controlled radiation areas or unlikely to receive an annual dose of over 5 mSv.

2. Locally monitored persons.

- In this category are persons not included in the previous category.

The RP Group carries out a continuous surveillance by ionising radiation monitoring systems over the whole CERN's site. The RP staff controls the monitoring system (dose levels, functioning, equipment positioning, etc) using software applications that allows a remote control of the area monitors. All installed radiation monitors can be read remotely. Data are stored in a database for future retrieval. Monitor parameters such as alarm threshold can only be modified by authorised personnel.

One of the purposes is to ensure an annual limit of 1mSv for the exposure of locally monitored persons. Also, with the aim of keeping exposures at the ALARA criteria, a reference dose of 15mSv per year has been introduced (instead of 20mSv/y) for persons categorised as ACT's, exposure leading to an annual effective dose over this value must be justified and authorised.

Access to primary beam area is supervised by the Accelerator Control Room. Access is controlled via a film badge reader that check if person is authorised to access the area (all personnel into the accelerator facilities has to wear the film badge and personal dosimeter and have access authorisation), if so the operator frees a key and gives access.

There are daily works that requires the control of RP personnel (normally previously scheduled). Radiation survey of the area include identification of hot-spots, evaluation of the average ambient dose equivalent, etc. A previous work of collaboration between the RP responsible and work supervisor for the estimation of time required for the work, and distance to hot-spots. With this, it is possible to get an evaluation of the integrated dose foreseen for the work, and establish actions to reduce the exposure (ALARA) as: removable shielding, rotation of personnel, training, specific instructions, etc.

The RP responsible of each experimental area has the responsibility to control the dose received in the works, and if the dose levels have exceeded the limit they must demand for stopping this worker exposition and always preserve the ALARA principle giving recommendations about how to avoid hot points, etc. At the beginning and at the end of the work doses must be entered on radiation log sheets placed at the entrance of the radiation areas, such RP responsible can evaluate personal radiation.

Main dose levels at CERN are received during the annual shutdown period. These are received during tasks of maintenance and change of equipment in primary beam area, the main doses are received by mechanic and transport staff, they can receive a limit of 1mSv per week. It is important to notice that there are no relevant levels of contamination at CERN's facilities. Although some times it exists and it is necessary delimitation of contaminated zones and preparation of specific material (gloves, etc).

2.1.2. Classification of Working Areas.

The RP group is responsible of designate certain parts of the fenced land belonging to CERN as free of supervision, supervised or controlled areas. These areas are classified as mentioned in Table I.

Table I. Classification of working areas.

AREA	Dose rate limit (mSv/h)		Consigne
Non-designated	≤0.15	≤0.5	– No film badge required. – Public exposure < 1mSv/year.
Supervised	≤2.5	≤7.5	– No film badge required. – Employees exposure < 1mSv/year
Simple controlled	≤25	≤100	Film badge required Employees exposure can not exceed 15mSv/year
Limited Stay	≤ 2mSv/h		– Film badge and personal dosimeter required. – Employees exposure can not exceed 15mSv/year.

AREA	Dose rate limit (mSv/h)	Consigne
High Radiation	> 2mSv/h but ≤ 100mSv/h	<ul style="list-style-type: none"> – Film badge and personal dosimeter required. – Strict access control enforced. – Access needs authorisation of RP group.
Prohibited	≥ 100mSv/h	<ul style="list-style-type: none"> – Access need protected by machine interlocks. – Access needs authorisation of division leader, medical service and RP group. – Access monitored by RP group.

1. Non designated areas: The RP group supervise dose limits are under limits of public exposure. Non information and/or delimitation is necessary.
2. Supervised areas: The access to these areas is free and there is no restriction on the length of stay or the duration of work. There are no special procedures for working but the working conditions are kept under review, there are site monitors. The RP staff controls the monitoring system and ensures an annual limit of 1mSv for the exposure of locally monitored persons. If the dose level is over the limit the area should be reclassified.
3. Controlled areas: The RP Group ensures that the warning signs required are displayed in these zones. Only individually monitored persons are allowed to work in these areas always wearing film badge. Because there are an important amount of changes in the external staff accessing to this zones, especial attention is paid by the RP group to the fulfilment of the procedures of behaviour. Controlled areas are sub-divided as follows:
 - Simple controlled areas. The sign of controlled area has to be displayed in a visible place.
 - Limited-stay area. There is specific signposting for this area, some specific information can be included in the signposting. There is an specific sign that can be used to indicate hot spots, or write additional information. There are procedures of access to this areas and the length of stay is always limited. There should be an authorisation to work in these areas including the specific condition to the work. If the hazard is only temporary RP group may install a mobile barrier using a yellow and black cord.
 - High-radiation areas. Additionally to the signposting, these areas have access doors locked. There are RP staff that is responsible for the area and only if the person in charge is present can be opened. If the level of radiation is linked to the operation of a particle beam, these areas are inaccessible during operation.
 - Prohibited areas. Additionally to the sign-posting, in case of accelerator operation there should be special illuminated panels functioning.

There is an specific radiation protection procedure for the signposting at work zones (TIS-RP Ref. EDMS 343645). In all the access point to the accelerators there is a radio protection office with material including those ones necessities for zones signposting. Only the RP personnel authorised can have access to this material.

2.1.3. Management of Radioactive Material.

All the radioactive material existing at CERN are under control by the RP Group. The radioactive material most frequently encountered at CERN comes from inside accelerator halls: Accelerator components, equipment and shielding materials.

The Group Leaders are responsible for ensuring that all persons assigned to work in the presence of radioactive material or sources are informed about the hazards.

The RP group is responsible for:

1. **Classify the material as non-radioactive** by an appropriate clearance procedure, except those that comes from an Basic Nuclear Installation (INB) area. IBERINCO has participated in process of clearance of iron blocks and soil.

2. **Labelling of radioactive materials.** The material in accelerators tunnels are activated during operation. The RP technician removing the material determine the activities levels.
3. **Handling of radioactive materials.** The radioactive material has to be handled exclusively in controlled areas. Special precaution has to be taken in case the dose rate on surface is over 2mSv/h at 10cm. Radioactive components are clearly marked with warning labels or panels. Except for weakly radioactive items (which are only marked by the trefoil), the label shows the dose rate at 10 cm distance and the date of the measurement.
4. **Control the exit and introduction of radioactive material at CERN.** All the material that goes out of CERN are controlled (for the dismantling of LEP accelerator, a gate monitor is being used). If a radioactive material was activated in installation outside CERN cannot be disposed at CERN, the material has to go to the laboratory of origin.

3. References.

1. Safety Policy at CERN, document CERN-SAPOCO/42, Rev., September 1994.
2. CERN Safety Code U1 Rev., Procedure for the control of Basic Nuclear Materials (BNM) on the CERN domain, 1994.
3. Radioprotection Procedure; La signalization des zones de travail (Ref. EDMS 343645).
4. CERN Radiation Safety Manual.