RADIATION PROTECTION AWARENESS CHALLENGES AT CERN

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ABSTRACT

At CERN (European Organization for Nuclear Research), physicists and engineers are probing the fundamental structure of the universe. They use the world's largest and most complex scientific instruments - particle accelerators and detectors - to study the basic constituents of matter: the fundamental particles.

Safety is a key concern and is based on raising workers' awareness of the multiple hazards they might face in a working environment as complex as that of CERN. Due to the rich professional and cultural diversity of CERN's population, developing safety courses and, in particular, radiation protection awareness, is a challenge with more than 33 000 persons trained over the last 20 years (online course and classroom training).

With the aim of continually improving quality and to meet the requirements of the demanding long technical shutdowns, CERN has modified the radiation protection awareness master plan and revised the methodology behind its design. This presentation traces the history allowing us to reach these objectives, gives an assessment of the current situation and outlines the future challenges for the upcoming years.

1. Introduction

CERN, the European Organization for Nuclear Research, is one of the largest scientific laboratories in the world. Founded in 1954, the CERN laboratory sits astride the Franco-Swiss border near Geneva. It has become an example of international collaboration for a "Science for Peace". Today CERN counts 22 member states, collaborates with some 600 institutes and universities and its vocation is fundamental physics, the discovery of the ultimate constituents of the matter and the laws of the Universe. For this, it uses scientific instruments such as purpose-built particle accelerators and detectors. By studying what happens when these particles are made to collide together at close to the speed of light, physicists are exploring the fundamental laws of nature. The operation of particle accelerators results in the creation of radioactivity. The accelerator complex includes experimental areas, fixed targets and about 45 km of tunnels harbouring the beam lines. These areas are designated by radiological risk and controlled by approximately 50 access points.

2. Safety courses

2.1 Some numbers

General safety is a key concern, it is based on workers' awareness of the risks they face in a working environment such as CERN. Because of the great professional and cultural diversity of the CERN population, safety awareness amongst employees is a real challenge: 2500 employees, 1,300 contractors and 12,000 scientific users for 120 nationalities are working daily onsite.

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Since 2013, safety training at CERN is shared between the experts in the various safety domains and the Safety Training Unit. The experts are responsible for the technical content of the courses and for keeping abreast with legal developments in their area of expertise. They work closely together with CERN's Safety Training Unit which manages and promotes the safety training program, advices the learners and their supervisors, creates courses with regards to didactic, graphics and organization, operates the safety training centre and is responsible for the traceability of the sessions held.

Today, CERN counts 77 in-house training sessions and 30 online courses for a total of about 36,000 participations per year on safety topics such as fire hazards, self-rescue masks, electrical hazards, etc. To deal with the diversity of the employees to be trained, the practical part of classroom training is an imperative. Consequently, the CERN training centre is equipped, in addition to the usual rooms, with practical workshops and simulators, such as a model of the LHC accelerator tunnel. These facilities make it possible to be trained in real conditions which is a real advantage for illustrating the pedagogical content of the safety courses.

2.2 Radiation protection regulations

CERN is an inter-governmental organisation. CERN' radiation protection legislation is based on European directives and needs to ensure a similar level of protection against ionising radiation as applied by the two Host States. To ensure compatibly, the "Tripartite" agreement between CERN and the Host States, France and Switzerland, was signed in November 2010. According to the European regulations (Directive 2013/59/EURATOM), French regulation (Article R4451-47 du code du travail) and the Swiss regulation (Ordonnance sur la Radioprotection 814.501 Article 10), CERN has a legal obligation to train its personnel on radiological hazards. Therefore, no equivalence is accepted because it provides in situ radiological awareness training. At CERN radiation protection awareness is given to people working in designated areas so that they can work without compromising their own safety, that of others or the radiological integrity of the installations. The awareness training is also a prerequisite for obtaining dosimeters and access to designated areas. In total, more than 6200 people have been trained on 2016 (online course and classroom training).

3. Evolution of radiation protection awareness

3.1 2012 revision

Initially, radiation protection awareness was based on a half-day training session with no practical part. During 2012, the Radiation Protection Group Leader proposed to the Host State Authorities to adapt the courses according to the risks. It was agreed within the framework of the "Tripartite".

A distinction was made between people working in controlled areas and those operating in lower risk areas, called supervised areas. The annual dose limit in a supervised area is 6 mSv whereas in the controlled area it is 20 mSv and in some cases, in addition to the personal dosimeter, the operational dosimeter is required. A "Supervised area" online course and a one-day "Controlled area" classroom training including a practical part have been created. If a person fails the online course "Supervised area" 3 times they will be invited to follow a "Controlled area" classroom training.

In 2012, the Radiation Protection Group created a Steering Board for radiation protection training. This board is composed of group members and the Head of the Radiation Protection Group.

At that time, the Radiation Protection Group was responsible for all aspects related to radiation protection training, with the exception of registration on these courses. In the following years, the Safety Training Unit took on more responsibilities and nowadays the Radiation Protection

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Group is mainly concerned with the technical content (including the practical part). The Steering Board has been kept – today mainly dealing with the content of these courses and ensuring that legal and technical changes (e.g. changes in laws, procedures, facilities, etc.) are taken into account.

3.2 ISOLDE

ISOLDE is an on-line isotopic mass separator dedicated to the production of a wide variety of radioactive ion beams for experiments in the fields of nuclear and atomic physics, solid state physics, material sciences and life sciences. This installation presents a risk of contamination in addition to the irradiation risk and, in 2014, classroom training was created with the aim of alerting the users to these two risks thanks to a predominantly practical part.

3.3 Modular approach

In 2016, a new approach was considered by the Safety Training Unit and the Radiation Protection Group in order to sensitize the whole CERN population and avoid redundancy within radiological awareness training. A "modular" approach emerged and is currently being implemented. This approach alleviates some existing awareness courses and adds two new courses:

• The online course "Radiation Protection Awareness" to inform the whole CERN population about radiological risks, whether or not they access a designated area. Amongst other things, this course raises awareness of the risks associated with the industrial radiographies that take place every day within CERN's perimeter. It also answers the various questions asked by personnel who are not under dosimetric follow up regarding the radiological risks that may be present in the vicinity of their workplace.

• The online course "Physics / Theory" to avoid redundancy of information on the theoretical and nuclear physics aspects between the different awareness courses.

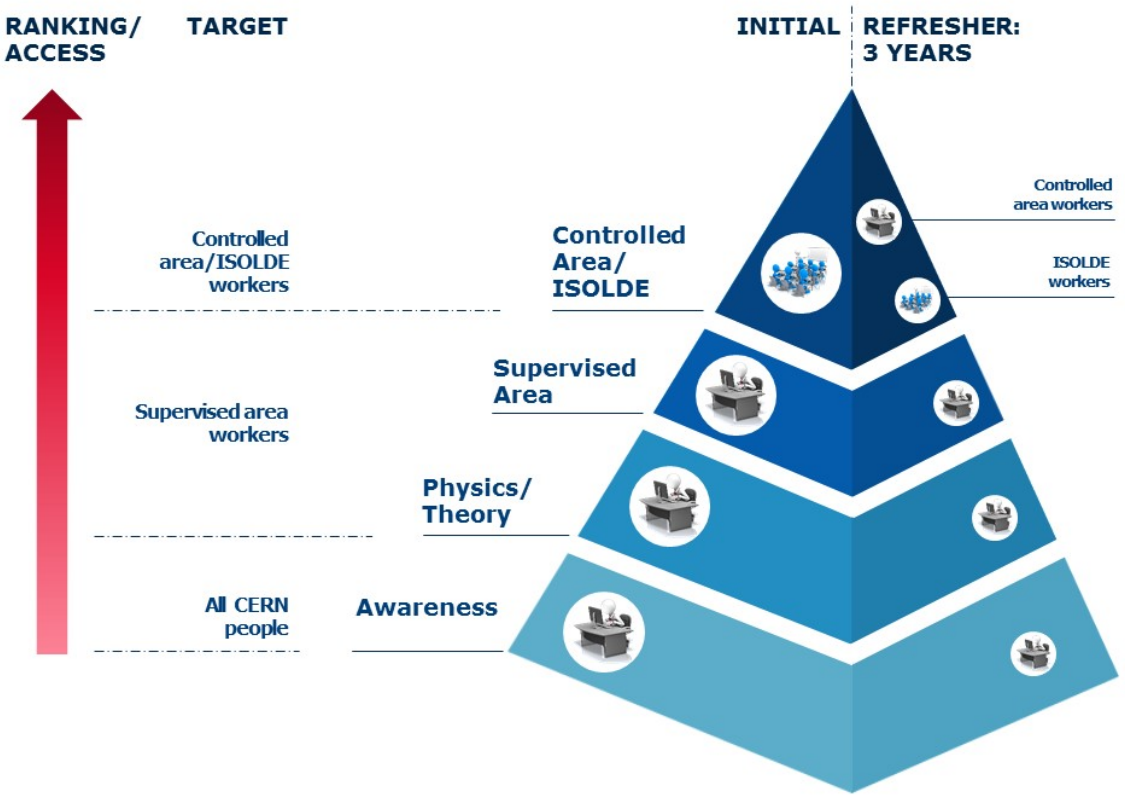

Fig 1. Modular approach for the radiation protection awareness courses

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As described above in Figure 1, each awareness course is a prerequisite for the succeeding one. Awareness courses will soon be coupled with access to allow a system that is structured and designed so that each person is aware of the absolute necessity to follow an awareness course before going inside a designated area.

Each awareness course concerns a clearly identified target population, enabling each supervisor to guide newcomers to an awareness course appropriate to their duties and the risks inherent in their workplace.

The Radiation Protection Group is also involved in the development of all other installation specific safety courses, in particular with regards to the radiation protection part. It is of utmost importance that there is a close collaboration between the experiments, the Safety Training Unit and the Radiation Protection Group as this allows harmonization, the absence of redundancy as well as the communication of the appropriate messages. The whole contributes to maintaining the quality of CERN's awareness courses.

4. Interactivity and tools

Online courses, treating the main theoretical concepts, are prerequisites for classroom training. For the latter, the practical exercises are favoured and make up at least 50% of the total time. The training is interactive thanks to the two adjoining rooms, with one dedicated to the theoretical part and the other one to the practical part. Alternating between the practical room and the theoretical room allows trainees to stay concentrated whilst illustrating the concepts in a playful, concrete and visual way. The acquired skills are therefore better memorised over time. The Radiation Protection Group has equipped the practical room with the same equipment used in the field at CERN. In addition, CERN has also acquired teaching aid instruments such as a Digital Particle Camera MX-10 © which is a detector allowing the visualisation of the different radiation-matter interactions and an STS 800 ©, a contamination detector simulated by a chemical agent. These tools allow trainees to carry out exercises in real conditions, to familiarize them with their working environment in designated areas at CERN, and to show them the way to behave and the reflexes to be acquired. The whole, without artificial or natural radioactivity. All these exercises are done within small groups to encourage interaction and stimulate reflection, which animates the training. For the theoretical part, participation is a major point, stimulated by the use of an interactive board. This facilitates exchanges and gives training courses tailored to the audience and makes it more attractive.

5. Specificity

The frequency of classroom training varies with the rate of experiments and technical stops. At least a weekly awareness course is ensured to offer newcomers the opportunity to take the required course, according to their very strict time constraints, in particular for scientific users or maintenance personnel. The duration varies from half a day to a day for classroom training and is about half an hour for online courses. Awareness training is provided in French and English, the two official languages at CERN (except for ISOLDE training which is in English only). Finally, each awareness course ends with a knowledge test to verify the key messages have been correctly understood. For the knowledge tests following the classroom training, thanks to the system of voting by remote control, it is possible to visualize the results immediately and to validate the session. In case a person fails, an interview is proposed by the trainer in order to judge the knowledge of the trainee and ask him to redo the test. Concerning the validity of the awareness training, after 3 years it is necessary to follow a recycling course. Because of the number of people to be trained, this is an online course.

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6. Methodology and tools

CERN's approach is not in itself innovative from the point of view of radiation protection awareness, but it seeks to have and maintain a high degree of quality for all aspects of awareness training, namely: the methodology of creation and the learning process, the system of continuous improvement and quality insurance and, in addition, for the classroom training alternating between theory/practice, the equipment used, the trainers' tools, the support material and the audits.

For the effective management and follow-up of the actions to be done, the JIRA Agile © tool is used. It streamlines the exchange of information and makes it possible to optimize the collaboration between the various actors by giving greater visibility on the progress of a project.

6.1 Development methodology, continuous improvement and quality insurance

The methodology for the development of awareness training consists of issuing key messages, in collaboration with the members of the Steering Committee and the experts of the Radioprotection Group. These experts are appointed by the Radiation Protection Group with the mission of validating key messages for the development of the content of a new course and performing an "expert surveillance" by tracking developments in terms of practices in the field to update awareness training with a review every 6 months. The graphic and pedagogical communication expert in the Safety Training Unit will illustrate these key messages. This visual and graphic design work is a competence in its own right and it is an important element because it is necessary to touch all the CERN population to promote the assimilation and understanding of key information. Dialogue with the trainers is not neglected in the development process because of their expertise on how to capture the attention of their CERN audience and their point of view is an important asset to exploit. Finally, when the first version is finalised, a test session is organised in real conditions to perform the final checks.

A system of continuous improvement and revision is set up for the awareness courses, based on the collection of feedbacks from audits and trainers, the analysis of the test results and the satisfaction questionnaires at the end of each classroom training. Moreover the regulatory surveillance and the update of practices in the field are also taken in account. All of this makes it possible to continually improve safety awareness to provide up-to-date information as close as possible to reality in the field.

6.2 Immersion and trainers' tools

Following their recruitment, the CERN trainers follow an "immersion" for a few days, this consists of visiting the various facilities and learning about CERN's procedures and rules supervised by the Radiation Protection group members to better understand the problems and to be able to communicate on these facilities with the trainees. This allows them to be confronted, like the trainees, with environments with a radiological risk and to better assimilate the safety rules. They are also better trained to understand the issues that can be addressed by trainees and thus better respond to their questions. They also receive "Train the Trainer" sessions, which consists of receiving technical information from an expert on a specific subject. The trainers rely on support material such as the pedagogical documents which gather all the technical information about the training such as the timeline and the key messages to be mentioned to the trainees for both the theoretical and practical parts. A website is available for trainers: it gathers general information on radiation protection at CERN and information e-mails are also sent regularly to circulate updates on radiation protection at CERN and what is new in classroom training.

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Finally, the Radiation Protection Group uses support materials, including a service charter, a charter for trainers and various procedures associated with classroom training and how to use pedagogical material.

7. Challenges

CERN's main challenge in terms of awareness training concerns setting up performance indicators to quantify the impact of awareness training, particularly in the field, which would make it possible to further improve the quality of the training.

Other practical questions arise such as the need to find a way to make the new online courses "Radiation Protection Awareness" mandatory for persons who do not have dosimetric follow-up.

8. Conclusion

At CERN, radiation protection awareness remains a key topic for promoting and improving safety at work. Thanks to methodologies based on the collaboration of skills, communication with trainers as well as the use of new technological means, it becomes more attractive and easily memorized in time; its impact will therefore be strengthened. The safety awareness of radiation protection for newcomers is their first contact with CERN and is a reflection of the work and organisation of radiation protection at CERN.

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