Sharing the access to large nuclear facilities for safety training: experience of an Erasmus intensive programme

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Abstract
A practical approach to the techniques used in large facilities is essential for the expertise of the students in nuclear and radiological engineering. A 2-week Erasmus Intensive Program "PAN: Practical Approach to Nuclear techniques" was organised each year from 2002 to 2005. The program included introductory talks and practical exercises, in particular exercises on a nuclear reactor and on different accelerators, as well as exercises organised in the teaching laboratory of the organising partner. Visits of specialised laboratories and medical departments, with practical demonstrations, were also proposed. A new IP project called "SPERANSA: Stimulation of Practical Expertise in Radiation And Nuclear SAfety" is accepted for 2006. The scope is partially redirected to nuclear/radiation safety, by developing the analysis of safety aspects related to the techniques used in the exercises. More similar activities are expected to be developed by the newly constituted network CHERNE.

1. Introduction

Safety questions are a permanent concern in nuclear and radiological engineering. This is particularly the case for large facilities like reactors or particle accelerators. Safety training is thus especially important for students in nuclear and/or radiological engineering.

Practical aspects are crucial in safety training. Many safety problems in the nuclear/radiological field find their origin in the lack of practical knowledge or understanding. An efficient safety consciousness must be based on the combination of a good understanding of both fundamental and practical aspects of the technology of the facility itself and of the protection technology.

Many institutions that propose a formation in nuclear and/or radiological engineering are able to provide a good practical approach to basic techniques like nuclear measurements and simulation software, but have little opportunities to organise practical training sessions on large facilities like reactors or accelerators. This problem might find a solution, at least a partial one, by sharing the existing possibilities at the European level.

2. The PAN courses

The 2-week Erasmus intensive program (IP) "PAN : Practical Approach to Nuclear techniques", was developed in this context. The consortium of partners initially included CVUT Prague, UPV Valencia and ISIB Brussels (2002). Two additional partners joined the project in 2003 (FH Aachen and XIOS-HL Diepenbeek). The common point between the partners is that they propose formations in the nuclear/radiological field in the second cycle (Master level), and the IP was mainly intended for students at this level. In the PAN courses, the main focus was on the technique itself, not so much on safety aspects. The teaching language was English.

The PAN course was organised with European support in 2002 and 2003 in CVUT Prague, in 2004 in Belgium (ISIB Brussels, with the help of IRMM Geel, SCK-CEN Mol and ULg Liège). A fourth edition with no external support was organised again in Prague in 2005. Besides introductory talks (approx. 10h), and practical exercises on specialised techniques in the teaching laboratories of the organising partners, the courses included practical work with a reactor and with accelerators, as well as visits (often with demos) in hospitals and various laboratories. No fee was asked, but a participation of the

students to the travel and accommodation costs was necessary, only a part of the budget being covered by the European grant.

CVUT Prague has a very nice modern training reactor “Sparrow”, a pool-type low-power reactor that may be used for many different exercises of variable complexity. After a basic demonstration of reactor control, the exercises proposed for PAN included activation flux measurement, delayed neutron measurement, void coefficient evaluation, and measurement of the reactivity of a control rod. Exercises on the use of accelerators were mostly performed on the Microtron of CVUT and on a radiotherapy linac. Visits were organised to hospitals (radiotherapy, nuclear medicine and PET, gamma-knife), to the Czech metrology institute (reference laboratory for radiation measurements), to the reactor, Van de Graaf and cyclotron in the research centre in Rez, and (2005) to the power laser facility and small tokamak of the Academy of Science in Prague.

Fig.1:The training reactor of CVUT, Prague

The 2004 edition in Belgium included exercises on the BR1 reactor (flux measurement with fission chambers and activation foils, subcritical approach, reactivity of a control rod, temperature coefficient) in SCK•CEN Mol, on the Van de Graaff (neutron fluence measurement) and LINAC (cross section measurement) of IRMM Geel, and on the cyclotron of ULg (PIXE, RBS). Visits with demos were organised to hospitals (radiotherapy accelerator, nuclear medicine and PET) and to the environmental radioactivity laboratory of the Public Health Institute. A visit to Hades (underground laboratory for the study of geological waste disposal) and Belgoprocess (waste treatment company) was also included.

Fig.2: The underground laboratory HADES in SCK•CEN, Mol

One consequence of the practical character of the course was the need to limit the number of participating students to 24, i.e. roughly 5 per partner, which also led to the limitation of the number of partners, despite the wish of other institutes to join the consortium. There is clearly some space to organise more activities of this kind. The creation of the CHERNE network (see hereafter) is an attempt to go ahead in that direction.

It may be seen from the program that the scope of the course was quite wide. This aspect was appreciated by a part of the students, but other would have preferred more opportunities to go deeper into one given subject. This difference was probably correlated to the variety of initial formations among the group, according to their affiliation. Although organizing a more flexible program with free choice of exercises would have been possible, the fear was that it would lead to a spontaneous reconstitution of national subgroups, and the priority was given to the constitution of international subgroups mixing the nationalities as much as possible.

Gathering 24 young people of 4 countries and 5 languages had of course many positive non-academic aspects for the students. As for the partner institutions, the organisation of the course proved to be an excellent way to trigger other collaborations, in education (Erasmus student exchanges, professor exchanges) as well as in research.

Fig.3 : Promoting the participation of young women is one of the objectives

3. The SPERANSA course

A new project of IP has been accepted for 2006: “SPERANSA, Stimulation of Practical Expertise in Radiological And Nuclear SAfety” . This project is an extension of the PAN course with a specific attention on safety aspects. It will basically include the same kind of practical exercises, but they will be systematically accompanied by an analysis of the relevant safety aspects, combining thus the practical contact with a technology and an approach of safety procedures and protection techniques related to it.

The course will be first organised by FH Aachen (more precisely its Jülich division) with the help of SCK-CEN Mol, IRMM Geel and FZ Jülich, for the same 5 partners as the PAN courses.

The program will include :

a) Lectures: approx. 10 h. The lectures will introduce the theoretical and regulatory aspects of the practical exercises.

b) Practical exercises with safety and/or radiation hygiene analysis: approx. 30 h. The list includes :

- reactor operation
- accelerator operation and application
- X-rays non-medical applications
- neutron measurements
- radiochemical separations and decontamination exercise
- quality control and patient protection in nuclear medicine and radiotherapy

Each student will participate to several but not all exercises.

c) Visits: approx. 10 h. Visits with demonstrations are foreseen for some facilities where a direct operation by the students is not possible.

d) Round tables: approx. 6 h

Round table discussions will be organized on the topics:

- ethical aspects of radiological and nuclear safety
- nuclear/radiological techniques and safety for sustainable development
- synthesis and evaluation of the course

The SPERANSA course will be attributed 3 ECTS, not including an optional knowledge control that may be organised afterwards by each partner according to its own rules.

4. The CHERNE network

The CHERNE network “Cooperation in Higher Education on Radiological and Nuclear Engineering” was recently established by the five PAN/SPERANSA partners, joined by the Universita degli Studi (Bologna) and the Universitat Politecnica de Catalunya (ETSEI Barcelona). The CHERNE initiative is a proposal to develop a non-formal wide-scope open network to enhance cooperation , competence sharing and equipment sharing between its partners. It is not seen as a concurrent to the existing networks and welcomes any activity that would be organised in collaboration with them. But it has its own organisational philosophy and wants to keep its specificity.

Starting in 2006, this non-profit network will accept other partners. No fee is asked, but any partner should contribute to the activities of the network. The information is centralised by the network secretary, now Professor Rodenas at UP Valencia.

CHERNE activities will mainly be training activities of at least 1 week and 2 ECTS, organised by one or several partners for students of any partner, mostly at the Masters level. CHERNE partners are attentive to the necessity to include practical training in their activities for the students, including when possible an access to large facilities. English will be the working language. The partners will try to define a few common periods during the academic year for the CHERNE activities, in order to facilitate the mobility of the students. When possible, these activities will be organised within the Erasmus exchange system ; the partners are thus encouraged to conclude bilateral Erasmus agreements.

It is expected that most partners will be academic institutions. However, cooperation with scientific institutions (nuclear research centre, …) is welcome and will be crucial for achieving the goals of the network.

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