Education and training courses on nuclear science, illicit trafficking, and environmental radioactivity - a JRC activity in EU enlargement and integration

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Abstract
Since 2003, the European Commission's Joint Research Centre has organised nuclear science training courses at the Institute for Transuranium Elements (JRC-ITU) in Karlsruhe, Germany, on a regular basis. The Commission has sponsored participants from candidate countries, potential candidate countries (Western Balkans) and new member states within its enlargement and integration policy in order to strengthen activities between the old, new and potential EU member states. The courses range from basic nuclear science and radiation protection with Nuclides.net [1], to illicit trafficking of nuclear and radioactive materials, and measurements of radioactivity in the environment. In line with actively promoting EU integration in regional resource centres, the most recent training course was organised jointly by the JRC and the Jožef Stefan Institute and was held at the Nuclear Training Centre in Ljubljana, Slovenia, in Sept. 2005**.**

1. Introduction: The JRC Enlargement & Integration Action

2004 was an historic year for the European Union, with its unprecedented enlargement to ten New Member States (NMS) – namely Cyprus, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Malta, Poland, Slovak Republic and Slovenia – extending the zone of peace, stability and prosperity in Europe. In support of the present enlargement process, the Joint Research Centre has undertaken extensive effort to integrate researchers, organisations and experts from the ten NMS and four Candidate Countries (CC), namely Bulgaria, Croatia, Romania and Turkey, within its activities and projects. Following the accession of the NMS, the JRC is now adapting its enlargement activities in order to focus on integration of the latter while continuing to promote collaboration with the four remaining CC and Potential Candidate Countries (Western Balkans).
The Enlargement and Integration Action (E&IA) of the JRC consists of a number of integrated instruments aimed at stimulating S&T collaboration, hosting temporary staff at the JRC Institutes, organising workshops and training courses and disseminating information within the NMS and CC. Endowed with a yearly budget of about 10 M€, complemented by additional funding from DG Enlargement to support the organisation of events, the E&IA has achieved significant progress in 2004 and has produced many results and deliverables for the benefit of the NMS and CC and their integration in the EU. These include:

- 98 workshops and training courses on various scientific and technical aspects of EU policies have been organised by the JRC institutes, with the participation of about 4000 experts mainly from the enlargement countries, but also from the (old) MS and neighbouring countries. A strategic collaboration has started with DG Enlargement's TAIEX unit (http://taiex.be) with the launching of a pilot action of five joint workshops.
- The number of visiting staff from NMS and CC working at the JRC has steadily been increasing. In December 2004 there were 154 researchers and experts from NMS and CC working at the JRC under temporary contracts (6 months to 2 years), who had been selected via open calls for manifestation of interest or via the "ELSA" database (www.cordis.lu/research_openings). Moreover, a competition has been organised for recruiting permanent research staff from the NMS.
- A number of information days have been held in the NMS and CC during 2004, namely in Czech Republic (Brno), Poland (Krakow), Slovak Republic (Bratislava and Kosice), Slovenia, Bulgaria, Romania (Bucharest and Lasi) and Lithuania, in the case of the Candidate Countries with the financial support of the Phare programme.

- Further to the European Council's recognition of the status of Potential Candidate Countries to five countries of the Western Balkans region (namely Albania, FYROM, Serbia-Montenegro, Bosnia and Herzegovina and Croatia, which recently become a Candidate Country), the JRC has also opened some 30 of its 2004 workshops to experts from these countries.

A collaboration with DG External Relations has been initiated in order to explore possible JRC support in the implementation of the European Neighbourhood Policy, which fosters increasingly close relationship between the EU and its southern and eastern neighbours, involving a significant degree of economic integration and a deepening of political cooperation.

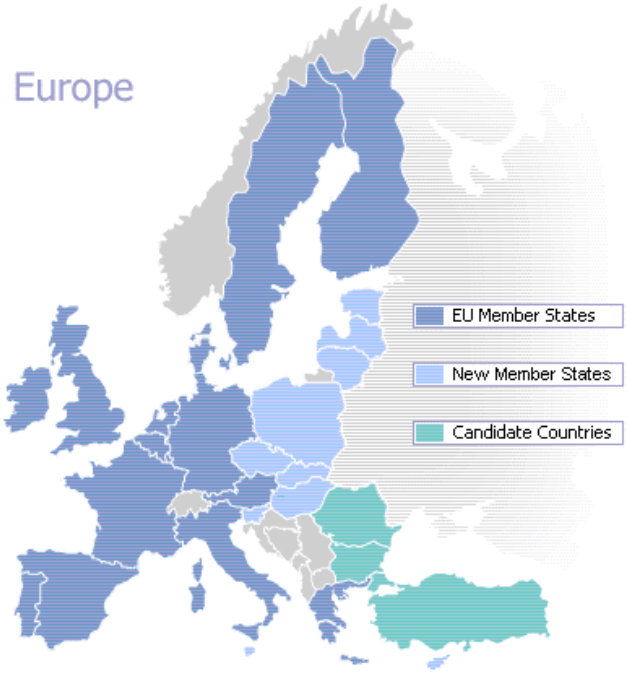

Fig. *1: EU Member States (http://www.eu2003.gr/en/cat/37/)*

2. The JRC Nuclear Science Education & Training Programmes at ITU

Illicit Trafficking

Starting from the early 1990s a steadily increasing number of seizures of nuclear material and radioactive sources have been reported, a significant portion thereof occurred in central and eastern European countries. The European Commission has been supporting projects to assist these countries in combating illicit trafficking. The activities comprise training, workshops, guidance for establishing response plans, joint sample analysis and demonstration exercises.
Three training courses with some 25 participants each, were organised since 2002 jointly with the IAEA and held at ITU. Staff from law enforcement agencies and national experts (from measurement laboratories) participated in the training. Specific technical training was provided:

- Law enforcement officers were given an introduction into the basics of nucleonics and of radiobiology, followed by an explanation of the principles of detection and identification of nuclear or radioactive material. Modern hand-held devices as used for on-site categorisation (i.e. to determine whether a sample consists of radioactive material like ^{60}Co, ^{192}Ir or of nuclear material like uranium or plutonium) were described. Practical exercises with these hand-held isotope identifiers (involving real samples) completed the training.
- National experts were familiarised with the methodology and the analytical techniques used in nuclear forensic analysis. Measurement techniques such as mass spectrometry, titration, electron microscopy were demonstrated as well as the use of the nuclear materials database for supporting the identification of the origin of nuclear material.

During these training sessions, the development of a national response plan to illicit trafficking of nuclear material was encouraged. The guiding document is the "Model Action Plan" (MAP) which was elaborated by the G-8 Nuclear Smuggling International Technical Working Group (ITWG). A number of countries adapted this MAP to their national specifics and implemented a "Response to Illicit Trafficking of Nuclear Material" handbook, describing the steps to be taken in case of a seizure of

nuclear or radioactive material and providing information on the authorities to be involved and their respective responsibilities.
In order to demonstrate the validity of the response plan, to identify potential deficiencies and to train the staff, demonstration exercises were held in Poland, Slovakia, Hungary, Romania, Bulgaria, Turkey and Lithuania
The experience gained in various countries, the problems observed and the progress achieved in combating illicit trafficking were exchanged during an international workshop, held in Vilnius (Lithuania) in October 2003. Furthermore, ITU experts were also invited to contribute to courses/seminars organised by the IAEA in South-Eastern Europe.
The Institute for Transuranium Elements has been offering a comprehensive training programme, which is embedded in country specific activities, e.g. joint sample analysis, demonstration exercises, development of a response plan and in international activities, e.g. international workshop. The activities are co-ordinated with relevant international organisations IAEA, ITWG, Europol.

Environmental Radioactivity
In the framework of the enlargement of the EU, the project on "Harmonisation of Techniques and Methodologies for Measuring Radioactivity in the Environment" started in 2003 at ITU. Laboratories from nineteen countries are currently participating in this project, including representatives from Western Balkan countries, which has involved an ongoing inter-comparison exercise between the laboratories for measurements of radionuclides in soils and sediments, with regular meetings to discuss the network activities and results. 2003 saw the start of two specific projects on "Methods of sampling of soils in cases of radiological alarm or routine verification" and "Analytical techniques for radiological alarm," together with an international workshop on "Radiation Protection of the Natural Environment and Human Health" in October.
Last year, twenty-four participants from five different countries attended a two-part training course on "Mass Spectrometry (ICPMS) for determination of radioisotopes". Its theoretical part was held in Hungary in April and was jointly organised with the Eötvos Loránd University in Budapest, with the practical part following six months later in Karlsruhe. Lastly, in December an international workshop, which was jointly organised with DG-Enlargement's TAIEX unit, on "Harmonisation of sampling & measurement techniques for the control of radioactively contaminated soils" brought around seventy participants from nineteen different member state, accession and Western Balkan countries to Karlsruhe. In addition, in May of this year, with the collaboration of the Slovakian Republic Authorities a field trial involving twenty scientists from new member states and accession countries was organised on the Dudvah River. Soil, sediment and vegetation samples were taken for the purpose of comparison of analytical techniques and a workshop took place with the help of the European delegation in Bratislava.

Nuclear Science Training Courses with Nuclides.net
This course started in 2003 and to date, six courses have been held (five at ITU, Karlsruhe). The 6th Nuclear Science Training course was held in Ljubljana, Slovenia and organised jointly with the Nuclear Training Centre of the Josef Stefan Institute. In total, over 200 participants from 12 countries have taken part in this 3-day training course. The course includes formal lectures on core and special topics (shown in table 1) given by experts in the field.

Core topics	Special Topics
Basic Concepts in Nuclear Science (History, Nuclide Charts, etc.)	Nuclear Forensic Science / Illicit Trafficking / Safeguards
Interaction of Radiation with Matter (range of charged particles & photons in materials, biological effects of radiation, hormesis & Linear Non-Threshold Hypothesis).	Nuclear Science with High Intensity Lasers Nuclear Medicine / Radio-immunotherapy with α-emitters
Reference / Nuclear Data	Environmental Radioactivity
Case Studies with Nuclides.net e.g. Dating of nuclear materials, Oklo nuclear geyser, Radiological dispersion devices	Radioactive Waste management / Decommissioning

Table 1. Core and Special Topics in the Nuclear Science Training Course with Nuclides.net

These are followed by a series of case studies and exercises based on the use of the commercial software package Nuclides.net developed at ITU [1,2]. Through the user-friendly web-based Nuclides.net (fig.2), the participant has direct access to nuclear and reference data from international datafiles and to applications based on the use of this data. Current applications range from decay calculations, gamma dosimetry and shielding, to fission yields and range calculations [3,4].

Fig. 2 (a) Nuclides.net software package [1] (b) Course textbook [2]

Recent case studies have covered Dating of Nuclear Materials (Haigerloch uranium), Oklo Nuclear Geyser, and Radiological Dispersion Devices.

3. Recent Example: 6th Nuclear Science Training Course, September 2005, Ljubljana

The Milan Čopič Nuclear Training Centre was founded in 1988 as an organisational unit of the Jožef Stefan Institute – the largest research organisation in natural sciences in Slovenia, which has been involved in the training of nuclear professionals since the early days of the construction of the nuclear power plant at Krško. The training centre has a staff of nine and is located 12 km from Ljubljana, on the same site as the research reactor TRIGA. Training centre activities can be divided into four main groups: training in nuclear technologies; radiological protection training for workers in medicine, research and industry; organisation of international training courses in collaboration with, for example, the IAEA, the EC and the US Department of Energy; and finally providing the public with information on nuclear science through organised visits and exhibitions for school children.
It was at this facility that the 6th nuclear science training course, jointly organised by the Jožef Stefan Institute and the ITU was held from the 14th – 16th September, 2005. The three day course covered a wide range of topics in the field of nuclear science and technology, and included case studies and exercises based on the ITU software package Nuclides.net. The lectures were complemented by a visit to research reactor TRIGA and a demonstration in centre's radioactivity lab. A total of thirty-eight participants, around half of them women, from new EU member countries and candidate countries, and with a diverse range of backgrounds attended the course in Slovenia. Among them were students, academics and industry professionals from fields such as nuclear medicine, radiation protection, environmental radioactivity and reactor physics. This was the first time that the training course was held outside Karlsruhe and it proved to be a remarkable success; discussions are already underway on holding future courses outside of Germany (for more information on this workshop see [5]).

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