STAR

(Contract Number: Fission-2010-3.5.1-269672)

DELIVERABLE (D-N°6.1)

Education and training in Radioecology: Supply and Demand Stakeholder Workshops

Author(s): Oughton, D.H., Barnett, C., Bradshaw, C., Real, A., Skipperud, L, Salbu, B.

Reporting period: 01/02/11 – 31/12/11

Date of issue of this report: **14/02/2012**

Start date of project: **01/02/2011** Duration: 54 Months

Project co-funded by the European Commission under the Seventh Euratom Framework Programme for Nuclear Research &Training Activities (2007-2011)		
Dissemination Level		
PU	Public	PU
RE	Restricted to a group specified by the partners of the [STAR] project	
CO	Confidential, only for partners of the [STAR] project	

[STAR]

DISTRIBUTION LIST

Name	Number of copies	Comments
A. Jouve, STAR EC Project Officer	1	Electronically (through webportal)
T. Hinton, STAR Co-ordinator (WP-1), IRSN	1	Electronically (word, pdf file)
L. Février, IRSN	1	Electronically (word, pdf file)
STAR Management Team members: WP-2; T. Ikaheimonen, STUK WP-3; M. Dowdall, NRPA WP-4; H. Vandenhove, SCK-CEN WP-5; J. Garnier-Laplace, IRSN WP-6; D. Oughton, UMB WP-7; B. Howard, NERC	1 per member	Electronically (pdf file)
STAR Steering Committee G. Kirchner, BfS A. Real, CIEMAT J-C. Gariel, IRSN T. Ikaheimonen, STUK H. Vandenhove, SCK-CEN C. Bradshaw, SU A. Liland, NRPA B. Howard, NERC B. Salbu, UMB	1 per member	Electronically (pdf file)
STAR Wiki site	1	Electronically (pdf file)
STAR's External Advisory Board	1 per member	Electronically (pdf file)
ALLIANCE members	1 per member	Electronically (pdf file)

Executive Summary

As part of the STAR Mobility, Training and Education work package (WP6) two stakeholder workshops were held to give insight into the recruitment needs within radioecology. The overall objective of the workshops was to bring a variety of stakeholders together to discuss the **supply** and **demand** for radioecology skills in its workforce today and in the future. The first workshop, on education and training **demand**, was aimed primarily at those who will ultimately employ candidates, but with additional participation from experts who could provide insights into the overarching drivers for radioecology in society, such as nuclear renaissance, decommissioning, accidents and regulatory changes. The second workshop on education and training **supply** was aimed primarily at those who are engaged in education and training in the nuclear sciences, but with additional participation from experts who could provide insights into the best way to tailor courses to meet the needs for society.

The workshops were successfully organised in Helsinki (May 20011) and in Oslo (November, 2011). In addition to STAR participants, a total of 47 stakeholders participated, with 5 attending both meetings. Both workshops lasted one and a half days and consisted of three separate half day sessions. Each session started with two to three introductory talks followed by discussions in small breakout groups and plenary feedback. Many themes were covered during the two meetings, and the main issues and areas of consensus are summarised below.

The question of what radioecology is was discussed at both meetings. A number of definitions were put forward, but common to all was that radioecology covers the environmental behaviour and effects of radionuclides, and that this was a multidisciplinary area. For the purposes of attracting students, there was consensus that environmental radioactivity would be more accessible and understandable to a wider audience than radioecology. But for describing the science and research, radioecology, or radioecology and environmental radioactivity was preferred.

Based on the many sources of radionuclides to the environment, knowledge on radioecology was likely to be needed well into the future. This includes from industry as well as authorities and regulators. Important sources include the nuclear fuel, nuclear weapons tests, legacy nuclear sites, nuclear fuel cycle, nuclear accidents, waste management, clean-up and remediation, hospitals and other non-nuclear industries. This all pointed to a series of research areas where recruitment was needed, covering most of radioecology, and including the urban environment.

Both workshops highlighted recruitment as being essential for the future of radioecology. It is important to influence young people, even undergraduates and school children, as research has shown that their interest in science should be encouraged at this stage. Radioecology should be promoted through a variety of courses at the BSc level – for example as lectures on other environmental science or nuclear science courses. There was a strong awareness of the need to better engage with industry and future employers. Concrete suggestions such as offering placements, joint research projects and summer jobs were activities that were proposed at both workshops. The multi-disciplinary nature of radioecology was an aspect that could be made attractive to students – there is both demand and a variety of possible job opportunities available to candidates.

Both to encourage recruitment, as well as for training and education purposes a series of tools should be applied, including social media (face book, twitter etc), web based tools such as e-learning, distant learning and web pages. However most agreed that analytical and experimental training must be based on hands-on laboratory exercises.

Finally there are several existing educational and training networks, and STAR needs to foster and strengthen existing links with these. Training in close connection to stakeholders, especially industry, will be important to secure that training is relevant. The networking and contacts made as part of these two stakeholder workshops will form a strong foundation to further developments in the STAR education and training activities.

On this note we would like to thank all the participants for their presentations, active discussions, their interest and effort as well as their contributions to the workshop. We will endeavour to maintain the momentum of this engagement, and keep participants updated and involved in progress on activities, for example through involvement in planning or teaching on courses, student exchange and research projects. Further information will be posted on the STAR website (www.star-radioecology.org).

ACRONYMS

AECL Atomic Energy of Canada Limited

BIOPROTA: Key Issues in Biosphere Aspects of Assessment of the Long-term Impact of Contaminant Releases Associated with Radioactive Waste Management

CEA Commissariat à l'énergie atomique et aux énergies alternatives

CINCH Cooperation in education in Nuclear Chemistry (EC 7th Framework Programme)

CTU Czech Technical University

DOE United States Department of Energy

DoReMi Low Dose Research towards Multidisciplinary Integration (EC 7th Framework Programme)

DTC Doctoral Training Centre (jointly run by Manchester and Sheffield Universities)

ECTS European Credit Transfer System

ECVET The European Credit system for Vocational Education and Training

ENEN-II European Nuclear Education Network (EC 6th Framework Programme)

ENETRAP-II European Network on Education and Training in Radiological Protection

ERICA Environmental Risk from Ionising Contaminants: Assessment and Management (EC 6th Framework Programme)

EURAC Securing European Radiological Protection and Radioecology Competence to Meet the Future Needs of Stakeholders (EC 6th Framework Programme)

IAEA International Atomic Energy Agency

ICRP International Commission on Radiological Protection

IRIS Interest and Recruitment in Science

IUR International Union of Radioecology

LUME LiveUSB Mediated Education

MoU Memorandum of Understanding

NCoRE National Center for Radioecology

NERIS European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery (EC 7th Framework Programme)

NoE Network of Excellence

NRPA Norwegian Radiation Protection Authority

OECD Organisation for Economic Co-operation and Development

PROTECT Protection of the environment from ionising radiation in a regulatory context (EC 6th Framework Programme)

ROSE The Relevance of Science Education (International Project)

SEPA Scottish Environmental Protection Agency

SETI Search for Extra Terrestrial Intelligence

STAR Strategy for Allied Radioecology

UNSCEAR United Nations Scientific Committee on the Effects of Atomic Radiation

WNA World Nuclear Association.

Table of contents

2 Introduction

The Strategy for Allied Radioecology (STAR) is a four and a half year Network of Excellence (NoE) funded by the EC. STAR was launched in February 2011 and aims to facilitate the long-term sustainable integration of European radioecological research. The recent renaissance of interest in nuclear power, the Fukushima accident, the application of nuclear techniques in research and industry, radionuclides released from the non-nuclear industries and the scientific challenges related to the whole nuclear fuel cycle, from mining to waste management, all require increased radioecological competence and support from further research. STAR will address a wide spectrum of issues in radioecology, including cutting-edge multidisciplinary research concerned with the environmental transport, fate, and effects of radioactive contaminants on humans and wildlife, access to shared infrastructures and equipment, and education and training courses to recruit young scientists to the discipline. With the help of the larger radioecology community, STAR will develop a Strategic Research Agenda and encourage worldwide collaboration on several focused lines of research.

As part of the Mobility, Training and Education work package (WP6) two stakeholder workshops were held to give insight into the recruitment needs within radioecology. A vibrant engaging program for long-term training and education within the nuclear and environmental sciences is required not only in order to have a sustainable nuclear energy program, but also for the assessment of possible impacts of any anthropogenic or naturally-occurring sources of ionising radiation. The ultimate goal of STAR's educational components is to meet the demand for both worker training and student education in an integrated and sustainable way. Such needs are particularly acute in the field of radioecology, as it has been recognized that formal training and education are fragmented, often inadequate, and that mobility is an essential means to support competence sharing. WP6 aims to strengthen and secure a sustainable integrated European training and education platform in radioecology that will attract top-level graduates and maintain a relevant workforce that is in a position to meet future economic and societal needs within nuclear and environmental sciences. WP6 is also responsible for the exchange visits between partners; training courses; MSc, PhD and post-doc programmes.

3 Workshop Objectives

The overall objective of the workshops was to bring a variety of stakeholders together to discuss the **supply** and **demand** for radioecology skills in its workforce today and in the future (recruitment). The first workshop, on education and training **demand**, was aimed primarily at those who will ultimately employ candidates, but with additional participation from experts who could provide insights into the overarching drivers for radioecology in society, such as nuclear renaissance, decommissioning, cold war and other nuclear legacies, accidents and regulatory developments. Issues discussed included:

- What is the future likely to hold,
- What are the drivers for recruitment from radioecology?

- What kind of skills are employers looking for?
- How should worker training be best implemented?

The second workshop on education and training **supply** was aimed primarily at those who are engaged in education and training in the nuclear sciences, but with additional participation from experts who could provide insights into the best way to tailor courses to meet the needs for society. Issues discussed included:

- What is Radioecology?
- What would be on the curriculum of a radioecology course?
- Satisfying requirements for European accreditation
- Recruitment
- Use of e-learning and social networking
- Engaging with industry and other potential employers.

Both workshops lasted one and a half days and consisted of three separate half day sessions. About 35 invited participants representing the scientific community (universities and research institutes) and stakeholders such as industries and regulators attended each of the workshops. Each session started with two to three introductory talks followed by discussions in small breakout groups and plenary feedback. The group discussions and summing-up were moderated by STAR members. The following chapters provide a summary of the two workshops, including a brief synopsis of the introductory lectures and a summary of the group discussions. Although there were three separate breakout groups for the issues discussed, the group discussions have been merged in this report.

4 Demand for Education and Supply: What skills are Employers looking for in their Workforce?

This workshop was held in Helsinki, from May 19-20th 2011 and comprised of 35 participants from 11 countries, including Canada and the United States, as well as the World Nuclear Association and the European Nuclear Society.

4.1 Setting the scene: what are the drivers for recruitment in radioecology?

Sylvain Saint-Pierre (WNA) made a presentation on behalf of the World Nuclear Association. WNA has contact with all key stakeholders of the nuclear field. The presentation covered the world needs for energy and the present situation regarding nuclear reactor new build. Large programs have been initiated (e.g. EU Generation IV) and are expected to progress. The Fukushima accident was also discussed, highlighting in particular the atypical nature of the situation. While it was thought that Fukushima might slow the nuclear renaissance a little, it was not likely to stop it. Usually an emergency lasts for hours or days, but in Fukushima the emergency period was, and still is, extremely long. Skills in radioecology would be needed in the workforce in all the big nuclear industries as well as in all National Government Agencies.

Malgorzata Sneve (NRPA, Norway) gave a presentation explaining the point of view from regulators. Regulation requires ensuring compliance with wide ranging requirements for protection of the environment and human health, including: interpretation of policy objectives; development of standards to meet the objectives; licensing; controlling that licence conditions are being met; enforcement action; and input to governmental policy. She stressed that the aim of "regulation" is not simply to meet limits, but to optimize the process as much as possible. Regulators are not only interested in having a lot of model parameters, but also want to understand what is behind those parameters and models. She concluded that regulations should be based on science, that there was a large need for radioecological expertise within regulators and authorities, and that a closer collaboration between research organizations and regulators would be beneficial. Examples of where radioecology competence is needed included regulatory supervision of legacy sites and the environmental impact and risk assessment used to support such supervision. Since radioecology is a part of ecology, not only radionuclides are important, but also the non-radioactive contaminants present in the environment.

4.1.1 Breakout session summary

The groups covered a very broad range of issues. There was a consensus that policy drivers are an important stimulation for research, not least because they define priority areas for funding. Discussion of the overarching drivers and areas **where** radioecology is important covered all situations where radioactivity could be potentially released to the environment, as well as processes spanning source term evaluation to risk assessment and remediation:

- Accidental, legacy and routine release scenarios.
- Nuclear fuel cycle: front end to back end.
- Spent fuel reprocessing and waste management.
- Non-nuclear industries (e.g., oil/gas, phosphate and mining industries).
- Hospitals and research organisations.
- Emergency preparedness and remediation.
- Non-proliferation, terrorism, orphan sources.
- Decommissioning.

Discussions of **why** radioecology is important to the above areas, and **what topics** it covers included:

- Scientifically based regulations improve the public confidence
- Providing the scientific knowledge and expertise to support demonstrations of industries meeting requirements and regulations.
- Building public confidence in safety to man and environment.
- The increasing demand from authorities to show lack of health and ecosystem effects.
- Improved understanding of the interface geosphere – biosphere. Central for a range of activities from fuel processing, waste disposal and U mining.
- Optimisation and justification (needs, knowledge and expertise ranging from chemistry, speciation, physics, biology, ecotoxicology and ecology, and the interface with economics and politics).

- Groundwater contamination and understanding the pathways of transfer and exposure to man and environment.
- Remediation: what level is good enough? Providing cost benefit analysis for establishing (site specific) clean-up criteria.
- Source terms (model inputs) depend on the source and the release conditions.
- Fundamental research, reducing uncertainties and highlighting knowledge gaps.

Challenges for the radioecology and risk assessment were identified as:

- Different protection values have been proposed (e.g., ICRP, IAEA/UNSCEAR, ERICA/PROTECT, etc) based in different approaches. Harmonization is needed.
- Different requirements for non-radioactive and radioactive substances; harmonization in regulatory frameworks is needed.
- Need for greater coordination and integration at different levels: regulatory, assessment, scientific, communication, regional and national.
- Mixed contaminants.
- "Exotic" radionuclides.
- Changing environments and sensitive ecosystems
- Less frequently studied environments (e.g. tropics)
- Integration of human and non-human biota assessment.
- Public communication and trust.
- Disagreements between experts.
- Effects of chronic low doses.

4.2 Needs and future challenges: What skills are employers looking for in their workforce?

The session was introduced by four short "comments" from industry, government and regulators.

Stephane Bourg (CEA) focused the talk on the need for competence within radiochemistry, since in France there is no special training in radiochemistry. He stressed that "motivated un-skilled people" are better than "un-motivated skilled people".

Ari Ikonen (Posiva, Finland and BIOPROTA) gave a presentation on behalf of BIOPROTA: Key Issues in Biosphere Aspects of Assessment of the Long-term Impact of Contaminant Releases Associated with Radioactive Waste Management. He highlighted in particular the need for improved knowledge and hard data on biosphere processes and key long-lived radionuclides (e.g., C-14, Se-79, Cl-36, Tc-99, Nb-94, I-129, Np-237). He also highlighted the importance of science to support the long-term assessment, as well as the importance of having enthusiastic people as well as skilled people.

Tim Jannick (Savanah River National Laboratory, DOE and NCoRE, USA), pointed out several governmental needs for radioecology such as environmental monitoring and surveillance, environmental modelling and impact assessments, long-term stewardship, and urban radioecology. Future research needs include the development of bio-indicators to reduce monitoring costs, and better characterization of the effects of low doses of radiation and of mixtures of contaminants. Hence governmental agencies need workers with skills in human health dose risk and assessment, health physics, nuclear engineering, genetics, environmental restoration and sequestration, geo-hydrology, soil science, forestry and ecology, general earth sciences and engineering, and environmental health physics, as well as inter-disciplinary skills. He also presented the NCoRE platform on radioecology recently created in the USA (Fig. 1), which will bring future opportunities in radioecology.

Paul Dale (SEPA), focused on the importance of assessments of routine releases (e.g., hospitals) as being a main body of the work carried out by SEPA. Within future work needs, there is the necessity of explicitly protecting the environment. Regarding the skills needed, he highlighted the importance of communication skills, and the need to be able to think holistically, critically and independently.

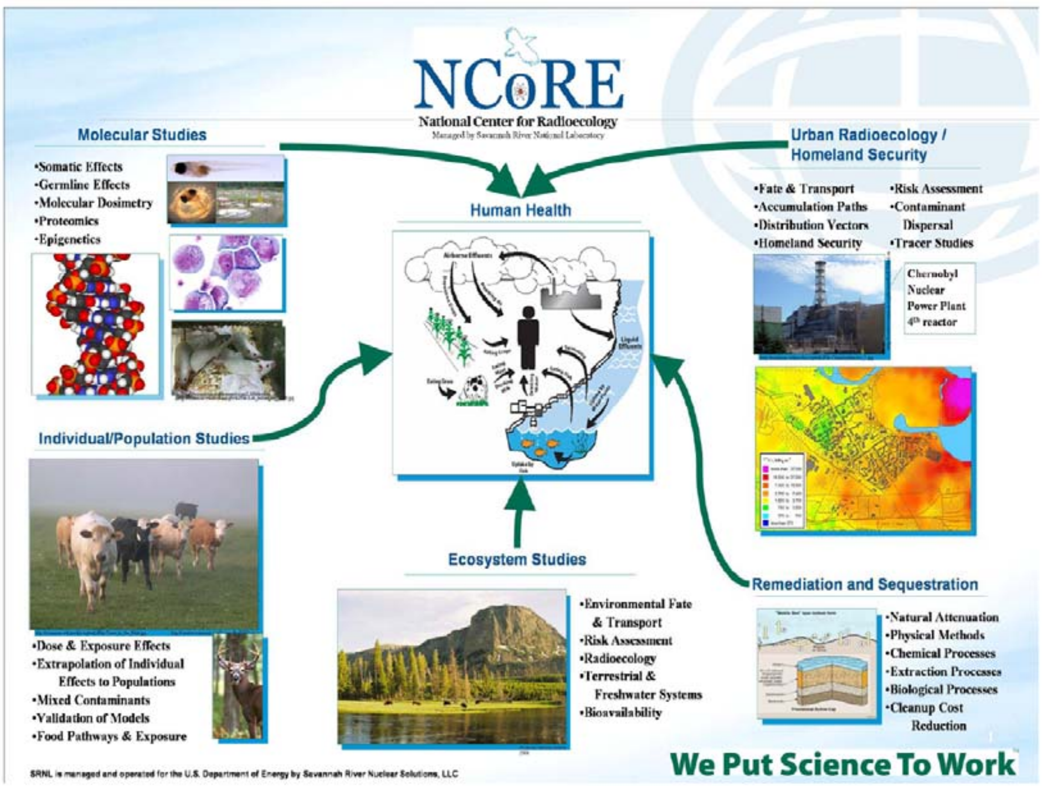

Figure 1: NCoRE platform (see also www.sml.doe.gov/newsroom/2011news/012611.htm)

4.2.1 Breakout session summary

The breakout groups addressed which general skills would be important, before turning to the specific skills that were needed in the workforce.

With regard to general skills all groups highlighted the need for motivation. In addition, communication and presentation skills – both oral and written, and to different audiences –

were deemed highly important. However, it was recognized that not every candidate would be expected to have these skills: e.g., some may simply be excellent modellers. Nevertheless, since radioecology and the required tasks require multidisciplinary skills, there would be a need for teamwork, and good project management or co-ordination skills should be equally relevant. Other general points were:

- Importance of practical skills and laboratory training.
- Be able to understand the results and be able to use those results.
- Be capable of critical, constructive and independent thinking.
- Multidisciplinary skills – requires contacts and networking.
- Be able to work in groups or teams, and be part of research team.
- Flexibility – be able to do many different things.

Specific Skills and Knowledge:

- Good natural science background.
- Basic understanding of ionizing radiation, SI units, radiation protection principles, radiation chemistry.
- Analytical skills, monitoring – capability of performing measurements of radionuclides and doses.
- Knowledge of dose – effect relationships for both human and non-human biota, basic radiation biology.
- Environmental chemistry, ecology.
- Knowledge about other stressors.
- Environmental transport modelling; ecosystem modelling.
- Environmental impact assessment.
- Regulatory and policy issues.

Workforce training covered many of the above points but stressed the wish for:

- Monitoring courses, especially to learn new techniques and methods of responding to emergencies.
- Modelling, programming and tools in all areas.
- Refresher or basic training courses on radiation protection, legislation and nuclear science and radiation chemistry.
- Laboratory courses that provide hands-on instrumental training.
- Field studies that provide opportunities for different disciplines to work together on a case.

Other general points covered the challenges of preparing courses for undergraduates and MSc students, as well as short courses for PhDs or other people working in industry or organizations. The use of consultants was also discussed, since this reflected the expertise that employers were seeking when outsourcing tasks to contractors. However for larger nuclear companies it was still thought that these skills would be needed in-house, even if outside support would be required. Even if the industry contracts consultants, they would still need experts to select a good consultant to do the job, and interpret the results given by the consultants.

4.3 Implementing education and training in the workforce: How to recruit students and candidates?

Jan John (Dept Nuclear Chemistry, Czech Technical University and co-ordinator of CINCH) gave a presentation on the EU Co-ordination in Nuclear Chemistry project (CINCH) as well as links to other European education and training networks in nuclear education. This included an overview of MSc modules at the Department of Nuclear Chemistry (DNC) and the Centre for Radiochemistry and Radiation Chemistry (CRRC), CTU, Prague. He stressed the importance of co-ordinating ongoing education programmes in Europe. He also stressed the difference between *education* which is a basic and lifelong learning process and *training* which is usually concerned with learning a particular competence required to perform a specific job.

Joseph Magill (JRC, Germany) presented an overview of the Nucleonica internet site and webtool linked to the Karlsruher Chart of the Nuclides. The presentation included insights into the various tools and applications (www.nucleonica.com). In addition to the standard nuclide data available from radioisotope tables, the web tool allows users to interact and use the applications, such as constructing gamma spectra. They have a learning centre within Nucleonica, as well as running training courses. The courses can be adapted to different requirements, for example, a recent course allowed construction of for example Fukushima source for modelling purposes.

4.3.1 Breakout session summary.

Groups started with gathering feedback on how the participants themselves entered, and stayed, in the field, before turning to how to get students interested, and especially how to increase collaboration between industry and educators

Personal interest and experience had arisen through:

- Personal curiosity, interests in the topic and wanting to know more.
- Controversial nature of radioactivity.
- Mentorship, stimulated by good teacher/professor.
- Short-term internships.
- Stimulating, challenging and variable work.
- Opportunities linked to scientific background, personal contacts, pro-active communication.
- Special events and real life problems, e.g. Fukushima, Chernobyl.
- Laboratory courses, practical and field work.
- Being able to follow the whole chain of scientific work, and be part of the bigger scientific picture.

Stimulating recruitment - general

- Increase visibility – get students interested because it is a hot topic and exciting – and highlighting there is a need in society for this competence. Make more use of social networking and forums (Facebook, Twitter, YouTube, blogs, etc.). “Open” radioecology to other disciplines, by giving talks on radioecology in other masters or undergraduate courses. Link to other nuclear areas. Invite potential students, including school children. Be clearer about what radioecology is (most people outside the field do not know!).

- Career Opportunities – the diverse nature of radioecology means that it is not necessary to specialise too early, and that students can be recruited from many different disciplines. There is a possibility for life-long career for students, in many different areas. Give indications of what kind of jobs that can be available in future. Define radioecology and give up to date information.
- Networking - Use each other's strength and use other platforms and NoE. Promote the opportunities for travel and taking courses in different countries. Stimulate links between stakeholders and universities – joint supervision of MSc and PhD students; Short-term employment internship; stewardship, summer job opportunities, joint research projects and master projects, etc.

Specific approaches to education and training

- Train the trainers!
- Train before conferences – offer certificates from conferences?
- Involve end users and stakeholders in training courses, there is a real need for continuous training of workforce.
- E-learning and distance learning provides the possibility of having a supervisor in other country; teachers can be accessed over the internet.

And last but not least, make use of inspiring people in the field – people that love what they do and can inspire the students to move forward with radioecology.

5 Education and Supply: How to Provide the Best Courses and Recruit the Strongest Candidates?

The demand workshop was held in Oslo, from November 15-16th 2011 and comprised of 37 participants from 11 countries, including Canada and the United States, the International Union of Radioecologists, World Nuclear Association, the BIOPROTA forum, as well as representatives from other EU projects (CINCH, DoReMi, NERIS, EURAC, ENTRAP).

5.1. Eye Opener: Why don't they love us anymore? Some perspectives from young people on science

Svein Sjøberg (UiO) made a presentation on studies into school children and young adults' perceptions of science based on experiences from international projects such as the ROSE study (The Relevance of Science Education, www.ils.uio.no/english/rose). While some of the different gender based perceptions of science were predictable, such as girls showing a tendency to be more interested in health and environmental sciences and boys mechanical and

IT subjects, the overall difference in interest for science and engineering in general –girls showing less interest than boys – was more marked in countries having a higher level of economic development. Similarly, children and young people in developing countries had a much more positive attitude towards science and technology than in Western countries. The importance of putting science subjects in a context that would increase interest was highlighted. A follow up EU project IRIS (Interest and Recruitment in Science, http://iris.fp-7.org/about-iris) is looking at ways to stimulate future students' interest and motivation.

5.2 Setting the scene: "What is radioecology?"

Francois Bréchignac (IUR) gave a presentation entitled "Radioecology 2012" looking at the present areas of research and future trends within radioecology. The International Union of Radioecology (www.iur-uir.org) defines radioecology as a multidisciplinary scientific discipline (biology, chemistry, physiology, ecology, biogeochemistry, geophysics, ecotoxicology, mathematics, metrology, etc), centered on the environment, and aimed at describing, understanding and predicting:

- i) the fate of radioactivity in environmental systems (artificial and natural);
- ii) its impact on man, via the environment, and on the environment itself: biota, ecosystems (human and ecological risk assessment) and
- iii) biogeochemical processes by means of tracer studies.

As such the discipline concerns a wide range of research areas, ranging from human to ecological impacts, and can be split along five main research axes: 1) source term, 2) transfer, 3) effects, 4) risk assessment and 5) tracer studies. In particular, the ecosystem approach has great potential for promoting radioecology within environmental science, bringing together human and ecological risk assessment.

Nick Priest, AECL, Canada and previous co-ordinator of the EU EURAC project and ENEN-II participant) gave a presentation on EU Radioecology Education Initiatives. These started with the EURAC project (Securing European Radiological Protection and Radioecology Competence to Meet the Future Needs of Stakeholders), which was a 2 year project focused specifically on education at the Masters and PhD levels. Surveys showed that despite only 4 MSc level courses being available in radioecology, compared to 17 in radiation protection, the discipline was as widely sought after by government and research employers. He stressed the importance of finding mechanisms to support mobility of students and staff to ensure the success of such European-wide courses. EURAC was followed by the ENEN-II project, which supported the initiation of the European MSc in Radioecology at UMB.

David Bytwerk (Oregon State University and NCoRE) gave a presentation on radioecology education in the United States. Like Europe, the US has seen a decline in radioecology within recent decades. While there are a number of dedicated health physics and radiation protection education programmes at many US universities, and many have some interest in the environmental behaviour of radionuclides, only two – Oregon State and Colorado State University – give specialist radioecology courses. This can lead to weaknesses in performance assessments, which apply models that have been developed to predict radionuclide transport and effects, but which ignore shortcomings in parameters on which these models rely. The education and training objectives of NCoRE (National Centre for Radioecology) initiative include to foster interdisciplinary collaboration among scientists in DOE, Federal and State agencies, universities and international research institutions in radioecology, as well as to establish a training and education program for radioecologists. They welcome the opportunity to collaborate with the STAR network.

5.2.1 Breakout Session Summary

The breakout groups were asked to address the question of course curriculum, syllabus and modules that might form the basis of MSc, PhD and worker training within radioecology. Not all groups addressed the three areas, as most focus was put on the proposed 10 credit MSc course, but a number of valuable suggestions were made both from the groups and in the following plenary session.

All groups covered the general issue of who the target for the course was. Is it intended to attract new students to the area, or as a specialist course that could be "sold" to students on other nuclear or environmental MSc or PhD projects? Some general points:

- The 10 credit (3 week) MSc course should be able to act as a distinct module for Radioecology MSc students taking a longer (e.g. 2 year) MSc programme, as well as a "teaser" for other MSc or graduate students that might be attracted into the area. There is also a need for some standalone lectures that could be used in other environmental science courses. Having an intensive course allows for participation of students from other universities.
- A hands-on laboratory course (5-10 credits) should provide a passport of mutual recognition for working with ionising radiation sources
- The MSc/PhD course (1-2 weeks, 5 credit) would be in a more specialised or in-depth area. Here the goal is not so much to attract students into a radioecology career – the students at this level have often already chosen their research or career paths – but to make courses that would appeal to a wide range of students, and also professionals, in all areas of nuclear science. Examples could be the Environmental Radiobiology or Ecological Risk Assessment PhD courses already offered to European Radioecology MSc Students
- Training courses should include training for teachers or others currently employed in jobs related to 'radioecology/radiochemistry' these will have to be shorter: 1 week maximum.
- Stakeholders may need different types or courses, focused in specific issues and shorter (e.g., one day course).
- Whatever course is proposed it will be important to know the background of the participants.
- The costs of the course need to be considered; lab and field experience can be expensive.
- All courses should make use of specialist guest lecturers.

The MSc course in particular should be scientifically based and also contain components that will attract the interest of a variety of different students, building for example on the exoticness of nuclear physics, controversy from accidents and the environmental, ecological and political aspects. The challenge is obviously to adequately cover all this in a mere 10 credit course, but some possible themes are presented in the table below, many of which could also be developed into specialist or training course.

Table: Examples of possible topics to be covered in the different courses

MSc (10 credit: 3 weeks)	MSc/PhD	Training
Sources (including disasters and accidents, non-nuclear industries) Transfer – food chain (e.g., radioactive Rudolf is a case all can relate to) Ecosphere/Biosphere/Geosphere Radioisotope dating and nuclear forensics Dirty bombs, terrorism and urban radioecology Environmental radiobiology Risk assessment and management Remediation Environmental impact assessment Multiple stressors Politics/public communication	LONG TERM LEGACY (they will start in the general course, but will continue in more "specific" courses) ENVIRONMENTAL RADIOBIOLOGY TRANSFER MODELLING	Erica Tool (the only one that has been used to date) RESRAD-BIOTA Nuclear waste issue
Practicals and Lab studies Radon measurements Site visits and measurement Small scale lab-experiments (Kds vs soil characteristics, bioassays, …) Practical training (e.g. many endpoint measurements like oxidative stress, ROS, …, can be conducted in short term) "Radioecology in Action" Participation of students in real site characterisation exercises, with follow up on how the characterisation data are to be and are used in assessments, leading to conclusions and/or need for further characterisation and assessment…	Could include an in depth study of a specific case such as Chernobyl summer school, Soave (Norway), Arctic, tropical site, tracer experiments ...	

As an overall curriculum for an MSc in radioecology (two year programme), proposed topics included radiochemistry, radiation protection, radiobiology, modelling, as well as legislation, communication and research methods – in short, all of the areas that make radioecology such a diverse science. Practical exercises and a research project (30 – 60 credits) would be important ingredients and the students should be offered incentives for travel. Both this and the diversity is something that should be attractive to the students. There is no need to specialize too early and there are plenty of different job opportunities exist. Experimental training will anyhow be essential, and the MSc must include such course modules. If combined with radiochemistry - radiation protection education, students passing the exam can obtain a "passport" allowing them to work with ionising radiation sources

There was some discussion on radon, both whether this is covered under radioecology (there was a suggestion that we deal with "outdoor" radioactivity, not with "indoor" radioactivity), and whether it would be an interesting subject at all for students. There was at least agreement that if it were to be included it should be of direct practical relevance, such as the opportunity to carry out a radon measurement in one's own home or place of study.

Finally, the question of whether to use the term Radioecology or Environmental Radioactivity attracted a lively debate. In the plenary session, there was a clear majority vote (99 %) to use the term Environmental Radioactivity, at least for the purposes of teaching and attracting students. It was considered less of a problem to use Radioecology in an overarching research and scientific arena. Radioecology is a science like ecology or biology, while environmental radioactivity is more a topic like pollution or global warming. But since to date the term radioecology is not so well known, environmental radioactivity would be likely to be more appealing to students, and particularly those from other areas of nuclear science who could be interested in taking specialist courses.

5.3 How to do it: Teaching and Training in the 21st Century

Michael Christie (Department of Education, Stockholm University) gave an introduction to the use of information communication technology in teaching, with a particular focus on Learning Management Systems (Virtual Learning Environments). Whereas most university teachers today use such systems mainly for uploading course lectures and materials, the potential for interactive and pedagogical use is starting to be realized. More focus should be paid to teaching and learning outcomes, and the role of assessments. Examples included the LiveUSB Mediated Education (LUME) which is a complete set of instructional material and software that can be bought together on a USB. Important questions to keep in mind whatever platform one is designing: i) Why do we want one? ii) Who is the audience? iii) How are we going to do it? and iv) What will be offered?

Hemda Garelick (Middlesex University) presented an overview of distance learning and work based learning for the development industry professional. This is a type of education and training for either the mature person at work who has specific training or developmental needs, or any worker who would like to progress through further education or awards. Distance learning is normally supplied by an accredited provider such as a university, and uses some form of level criteria, but can be accessed with minimal physical attendance. Work based learning can offer academic accreditation of the daily learning that takes place at the workplace, and can be directed to both employees and students.

5.3.1 Breakout Session Summary

Following a brief demonstration of some of the web-based and e-learning tools available within nuclear, chemistry and environmental science (e.g., Nucleonica (www.nucleonica.com) Plymouth University gamma spectrometry tool (http://www2.plymouth.ac.uk/science/radiationexperiments/radiationsimulations.swf), The periodic table of the elements (www.periodictable.com; www.webelements.com), The periodic table of videos (www.periodicvideos.com)), the participants broke up into three different groups addressing three different areas: 1) e-learning platforms and management; 2) social media and 3) web-based tools and e-learning tools. All considered the "Why, Who, What and How" questions posed by Michael Christie for their discussion of the different tools.

5.3.1.1 Virtual Learning Environments / Learning Management Systems

Why? Do we want one?

- Well known system and standard in many countries (e.g. Moodle in the UK), and Fronter type system used for education at most universities in Europe.
- There is a big opportunity for students to interact.
- Secure, safe environment (usually limited access to teaching materials for students).
- One portal for everything.
- Can be innovative.
- Good for assessing plagiarism (both students – self assessment, and teachers).
- Can stream lectures.
- Is a support to both distance learning and face-to-face.
- Can save resources in the long run (but may need quite an investment in time and money in the beginning).
- Flexible (pre-preparation, students with different learning abilities, e.g. dyslexia, or preferences, good aid to overcome language barriers).
- Mobility (also for working people that want to follow the course): can save a lot of time and money.
- Accountable (to funders, students, teachers) – statistics available on frequency of use/participation etc. Good for course evaluation. Also good if want accreditation.
- But on the negative side it is hard for people with poor internet/computer facilities; frustration with technology.

Who is the audience?

- MSc, PhD, worker training (Distance Learning is preferred by them, flexible scheduling); Teachers
- Important to distinguish between platforms with internal access (students attending course modules) and open platforms (Open access and IPR-issues)

How are we going to do it practically?

- At the start we need "guidance" on how to use it (the rules to follow). Start with easier usage to get people used to the technology
- "Flexibility" is much appreciated (students can organise their time)
- All the content must link to the assessment
- "Safe environment" for students and teachers (to do comments and to check the content added): Clear rules for discussions if use a forum
- Carrot vs stick!
- Make it an integral part of the course
- Use stimulating questions / assignments / topics
- How is it going to work in relation to the training and education pages on the STAR website? (see open access comment above)

What will be offered?

- In general there will often be a pre-existing system already in use; but make sure that there is one system only. Technical support must be available
- Continuous formative assessment – good feedback (either to group or individual)
- Online discussions (can assess them too!)
- Streamed lectures (though videoconferencing may be more appropriate – Skype, Adobe Acrobat)
- Follow up intensive courses
- Quizzes, exercises, multiple choice tests can be provided
- Peer learning and assessment

5.3.1.2 Social Media

Why Social Media?

- Wide target audience
- Easy access to information
- Possibility to share information with a lot of people
- Marketing radioecology to a larger audience

What Social Media are available?

- Facebook
- Twitter
- LinkedIn
- Blog?

What can I use Social Media For?

- Promoting radioecology
- Promoting courses

How can Social Media be moderated?

- Page owner
- Dedicated group
- PR group

5.3.1.3 Web-based and e-learning tools

What is available?

- Virtual reality simulations (e.g., walking through a contaminated area)
- Animated tools
- YouTube
- Educational Games
- Interactive tools (e.g., periodic table/Nucleonica)
- Video of lectures
- Powerpoint or whiteboard (with voice over)

- Specific examples of other tools and interactive activities- SETI (Search for Extra Terrestrial Intelligence); Rodos model; urban model (developed by Risø) SKB – environment changes

Why do we want them?

- Educational – supporting, not replacing education
- Stimulates interest
- Saving time and money?
- Self paced for student
- Flexibility for the students
- Dissemination

Who is the audience?

- Public
- Radioecology student
- General student
- Stakeholders
- Journalists
- Professional development
- Teachers of radioecology
- Teachers of school students
- Administrators
- Policy makers
- The media/platform strategy will depend on the audience

What would we like to produce?

- Dynamic visual models showing radionuclide movement through the environment (e.g. comparison of I and Cs)
- I-pad simulations/applications
- Walkthrough and gaming options
- Remote sensing - dosimetry and live monitoring of animals
- Nucleonica or periodic table type applications/add-ons (e.g. element or nuclide specific information such as Kd, environmental half life, transfer factors, important foodstuffs, dose conversion factors, source terms, etc…)
- YouTube videos. Examples: Wildlife impacts at Chernobyl; Ecosystem dynamics/changes – linked to remote dosimetry? Uses of tracers (e.g. Groundwater tracing; climate change; foodweb structure); dating (Pb/Cs in sediments; Th-C dating); AMS technology.
- Career options – interview radioecologists from different professions.

General comments

- Need passionate people.
- Need young people to present the information; Use students to make videos/tools as project assignments (e.g., as part of PhD research school)
- For some uses 5 minutes video is too long.
- KISS (Keep it Simple, Stupid)

5.4 How to do it: Networking and Funding

Michele Coeck (SCK-CEN and ENETRAP-II) presented a general overview of EU education and training platforms, and gave some more detailed background to the ENTRAP programmes. Some examples of DG RTD 7FP projects (European Fission Training Schemes) include:

- ENEN III which focuses on competences needed by nuclear system suppliers (specific attention to system and process engineering, safety analysis evaluations, HVAC, ICT engineering); 4 training schemes are developed: Basic nuclear topics for non-nuclear engineers, Design challenges for gen III NPP, Construction challenges for gen III, and Design challenges for gen IV reactors;
- PETRUS II focusing on competences needed by radwaste agencies;
- TRASNUSAFE. The objective of this project is to design, develop and test two relevant training schemes on Nuclear Safety Culture for managers of nuclear installations in nuclear industry and medical, based on a specific evaluation of the training needs obtained via a questionnaire and the organisation of reflection groups;
- CINCH concentrates on competences required by nuclear and radio-chemistry, for example chemistry of nuclear fuel, separation chemistry, chemistry of actinides, radio-analytical chemistry, low-level detection of radionuclides, radio-pharmaceutical chemistry, etc;
- The EUTERP Platform was raised in 2006 by DG TREN and was supported by it for a period of 3 years. It became a self-sustainable Foundation (under Dutch law) only in June 2010 (www.euterp.eu). EUTERP gathers all stakeholders in E&T in radiation protection (E&T providers, authorities, end-users, etc.).

The overall objective of ENTRAP-II is to develop European high-quality "reference standards" and good practices for education and training in radiation protection (RP), specifically with respect to the radiation protection expert (RPE) and the radiation protection officer (RPO). These "standards" will reflect the needs of the RPE and the RPO in all sectors where ionising radiation is applied. The introduction of a radiation protection training passport as a means to facilitate efficient and transparent European mutual recognition is another ultimate deliverable of this project. It is envisaged that the outcome of this project will be instrumental for the cooperation between regulators, training providers and customers (nuclear industry, research, non-nuclear industry, etc.) in reaching harmonization of the requirements for, and the education and training of RPEs and RPOs within Europe, and will stimulate building competence and career development in radiation protection to meet the demands of the future.

Neil Hyatt, (Sheffield University) gave a presentation on the Nuclear First Doctoral Training Centre (DTC) that is jointly run by Manchester and Sheffield Universities. The centre was designed to address the concerns raised about the quality of some UK PhDs in engineering and physical sciences. The general aims of a DTC are: to increase focus on the key challenges for society; to encourage more ambitious and transformative research; to attract and nurture talented and skilled people; and to more effectively translate research to solve societal challenges. In 2011 the UK had 77 DTCs split between PhD and industrial (EngD) training centres. The Nuclear First DTC is one of these, and admits 10 students a year, having an application rate of 6:1 for the available places. The students start with a 1 year MSc set of 7 modules, one of which is environmental radioactivity, and two mini research projects, before progressing to the 3 year PhD thesis project. The support of industry and engaging with stakeholders is a central part of the centre. The education system is, however, not fully compliant with the Bologna model.

Kym Jarvis and Susan Perry (EMpower, UK) EMpower is the Masters Programme of Work Experience through Research, that is operated on behalf of the UK Nuclear Industry by the Viridian Partnership (www.EMpowerinfo.org). The overall objective of EMpower is to give MSc students, who may not necessarily consider employment in the industry, a positive exposure to the Nuclear Sector through Research project placements. It was set up in response to an acknowledged skills shortage following a UK Government report (2002). This proposed that environmental Masters courses could represent a hitherto untapped recruitment stream. In particular, scientific skills were needed for nuclear decommissioning & waste management include analytical chemistry, geochemistry, geology, land remediation, hydrogeology, wastewater engineering, occupational health, biochemistry, ecotoxicology & others. EMpower has operated for 4 years, and from about 200 applicants has placed 44 Masters students from 25 universities across the UK. Project placements usually last for 3-5 months (depending on the requirement of the particular course). Students receive a bursary to off-set additional costs incurred during the placement and travel and subsistence.

Jan John (CINCH) held a presentation on the new European evaluation system, the ECVET European Credit System for Vocational Education and Training, where the credit system focuses on what students CAN do after obtaining a degree, more than how they have obtained their degree, by defining specific "learning outcomes" to acquire specific competencies in a nuclear sector. Although the system is driven by the EC and still not compliant to the Bologna model, he was convinced that the system will be implemented all over Europe.

5.4.1 Breakout Session Summary

The overarching theme of the breakout session was sustaining the nuclear and radioecology education and training platform. The three groups were all asked to address three specific questions: 1) How can you contribute? 2) What are the challenges in international training and education 3) How can E&T initiatives be funded? 4) What vehicles are available?

5.4.1.1 How can you contribute?

The response from participants to actively contributing to education and training in radioecology was extremely positive. This included providing students, teachers, work placements, research projects, collaboration on courses or course modules, educational material and logistical support for student exchange. This enthusiasm is encouraging for the STAR project, and the challenge will be for STAR to realize these opportunities – potential hurdles are discussed in the next sections…

5.4.1.2 What are the challenges in international training and education?

- *Funding (see also point below).* With respect to specific funding for student mobility, three areas need to be considered: payment to the university organising the course (e.g. fees or registration); payment for travel and subsistence and payment for specific course or project expenses (fieldwork, practicals, analysis). Practices vary from country to country. In Norway the fee is rather small (50-100 €), while in the UK it can be a problem because universities can charge high fees. The fee is typical of an issue that can be solved within a Joint degree system. With respect to travel and accommodation abroad, there are some EU arrangements whereby students can be funded (e.g. ERASMUS, Marie Curie). However, separate proposals need to be submitted/accepted

- *Accreditation:* Course modules provided by one university are not automatically recognized by others. The Bologna model is, however, helpful and the provided ECTS credits are accepted according to an international standard. The SOCRATES programmes are another way to ensure recognition. Most universities will allow for courses to be considered as part of a PhD or MSc even if they do not give ECTS, although most students do not appreciate such systems. Memorandums of understanding (MoU) and Joint agreements/Joint degrees systems can solve the problem.
- *Logistics.* PhD student "mobility" can often be simpler than for MSc (less paper work, already funded). If a student goes to an industry, is not easy to control how the student is supervised. In most universities there are "international offices", STAR should check these offices to see how they work with international students participating in courses.
- *Language and cross-cultural issues:* requirement for documentation of proficiency in English; safety and security regulations: and different expectations between countries. A "passport" arrangement for documentation which would demonstrate competence for working with radioisotopes should be mutually recognised.
- *Dissemination:* How to disseminate the information on these courses (MSc courses and PhD opportunities). Need to also consider courses for supervisors. Need to promote the education opportunities to industry.

5.4.1.3 How can education and training initiatives be funded? What vehicles are available?

- STAR and other EC programmes typically run for 3-4 years, then funding stops, so there is a real need for sustainable mechanisms.
- Make use of existing student exchange mechanisms (e.g. country-specific with Canada, or ERASMUS).
- Joint research project including programme (e.g. BIOPROTA) or industry funded.
- Need harmonization with existing E&T initiatives, both EC and other platforms such as IAEA and OECD.
- Marie Curie? Apparently it is not possible to apply for a Marie Curie through Euratom. This should be discussed with the EC, if possible in combination with other platforms (e.g. Melodi/DoReMi) that have an E&T WP, in order to try and exert pressure on them.
- Stakeholders / industry are an untapped source – we need to persuade them that they need us. Consider an EMpower or Nuclear First type of system.
- IUR. Although they have limited funding, they are a good advertising channel for our E&T initiatives.

- Use distance learning to reduce costs, as well as streamed lectures via videoconference, VLEs etc.
- Since education is research based, this may cause problems for open access platforms due to IPR

6 Conclusions and the Way Forward

The workshops were successfully organised in Helsinki (May 20011) and in Oslo (15th-16th November, 2011). There were a number of themes that recurred at both meetings, and agreement on a number of discussion items.

The question of what radioecology is was discussed at both meetings. A number of definitions were put forward during the meetings:

IUR: a multidisciplinary scientific discipline (biology, chemistry, physiology, ecology, biogeochemistry, geophysics, ecotoxicology, mathematics , metrology, ...), centered on the environment, and aimed at describing, understanding and predicting: i) the fate of radioactivity in environmental systems (artificial and natural); ii) its impact on man, via the environment, and on the environment itself: biota, ecosystems (human and ecological risk assessment) and iii) biogeochemical processes by means of tracer studies.

NCoRE: the science that investigates the movement and effect of radionuclides released to the environment. It combines expertise in physics, chemistry, mathematics, biology, ecology and radiation protection

STAR: the study of the behaviour and effects of radioactive elements in the environment and measures exposure to radiation of humans and other organisms (for example www.star-radioecology.org or Parliament magazine article, Fig 2).

All agreed that radioecology covers the environmental behaviour and effects of radionuclides, and that this was a multidisciplinary area. There were some queries as to whether this could include non-radioactive elements (e.g. stable isotope tracers or chemical impacts of, say uranium), and the question of whether the term was recognised outside the nuclear sciences. For the purposes of attracting students, there was consensus that environmental radioactivity would be more accessible and understandable to a wider audience. But for describing the science and research, radioecology, or radioecology and environmental radioactivity was preferred.

Based on the many sources that may release radionuclides into the environment, knowledge on radioecology was likely to be needed well into the future. This includes industry, including as preparedness for future nuclear accidents, as well as authorities and regulators, since research forms the basis of much regulatory work. Other important sources included nuclear weapons tests, legacy nuclear sites, nuclear fuel cycle, nuclear accidents, on-going activities, waste disposal, clean-up and remediation, hospitals and other non-nuclear industries. This all pointed to a series of research areas where recruitment was needed, covering most of radioecology, and including the urban environment.

Both workshops highlighted recruitment as being essential for the future of radioecology. It is important to influence young people, even undergraduates and school children, as research has shown that their interest in science should be encouraged at this stage. Radioecology should be promoted through a variety of courses at the BSc level – for example as lectures on other environmental science or nuclear science courses. There was a strong awareness of the need to better engage with industry and future employers. Concrete suggestions such as offering placements, joint research projects and summer jobs were activities that were proposed at both workshops. The multi-disciplinary nature of radioecology was an aspect that could be made attractive to students – there is both demand and a variety of possible job opportunities available to candidates.

For the students and candidates themselves, we should put as much focus on personality as scientific skills, they should be open-minded, contribute with constructive criticism, be interested/active and creative. Analytical and /measurement skill will be important, while they should have experience from interdisciplinary science.

Both to encourage recruitment, as well as for training and education purposes a series of tools should be applied, including social media (face book, twitter etc), web based tools such as e-learning, distant learning and web pages. However most agreed that experimental training must be based on hands-on laboratory exercises.

Finally there are several educational and training networks, and STAR needs to foster and strengthen existing links with these. Training in close connection to stakeholders, especially industry, will be important to secure that training is relevant. The networking and contacts made as part of these two stakeholder workshops will form a strong foundation to further developments in the STAR education and training activities.

On this note we would like to thank all the participants for their presentations, active discussions, their interest and effort as well as their contributions to the workshop. We will endeavour to maintain the momentum of this engagement, and keep participants updated and involved in progress on activities, either directly or through the STAR website (www.star-radioecology.org).

RADIOECOLOGY - Advancing the Science of Protecting Humans and the Environment from Radiation

Decision makers and the public need accessible, understandable information about the many different issues concerning radioactivity in the environment. Scientists need to provide independent guidance based upon well founded research. This is especially important in the aftermath of the accident at Fukushima and at a time when many countries are considering new nuclear power stations.

Radioecology is the study of the behaviour and effects of radioactive elements in the environment and measures exposure to radiation of humans and other organisms.

Radioecologists consider many sources of natural and manmade radioactivity. They also develop methods of reducing people's exposure to radioactivity such as those used after the Chernobyl accident. These skills will again be required in response to the Fukushima accident.

Radioecology became a strong discipline in Europe in response to the Chernobyl accident. But now, as experts retire, expertise is being lost and is becoming fragmented across Europe. **The STAR consortium, funded under the EURATOM programme aims to stop this decline.**

STAR a new *European Network of Excellence*

...will **INFLUENCE** the course of radioecology by:

- **APPROACHING** our science in a new, integrated way
- **ADDRESSING** complex research priorities that only a consortium of partners can accomplish
- **INFLUENCING** the future direction of research via a long term strategic research agenda

...will **OFFSET** the decline of radioecology by:

- **INSPIRING** the interest of youth to participate in our science
- **EDUCATING** stakeholders about the value of our science
- **INTEGRATING** nine organisations from eight countries, taking advantage of our diverse cultures, approaches, locations, expertise, and interests

Visit our websites
www.star-radioecology.org
www.european-radioecology.org

STAR Coordinator:
Tom Hinton (IRSN, France)
thomas.hinton@irsn.fr

EUROPEAN RADIOECOLOGY ALLIANCE

APPENDIX

Workshop organisers and secretariat

Workshop Participants

Workshop agendas

Workshop Organizers, Helsinki

Deborah Oughton, UMB
Brit Salbu, UMB
Almudena Real, CIEMAT
Hildegarde Vandenhove, SCK

Workshop Secretariat, Helsinki

Lindis Skipperud, UMB
Ole Christian Lind, UMB
Iisa Outola, STUK
Samu Inkinen, STUK

Workshop Organizers, Oslo

Deborah Oughton, UMB
Brit Salbu, UMB
Clare Bradshaw, SU
Almudena Real, CIEMAT

Workshop Secretariat, Oslo

Lindis Skipperud, UMB
Mirian Wangen, UMB

Demand Workshop Participants

Stakeholders

Stephane Bourg, CEA, France
Paul Dale, Scottish Environmental Protection Agency (SEPA), UK
Claire Callies, Environment Agency, UK
Diego Echenique, MBA student, France
Kai Hämäläinen, STUK, Finland
Ari Ikonanen, Posiva/ BIOPROTA, Finland
Tim Jannik, Department of Energy (DoE), USA
Jan John, EU-CINCH project, Czech Republic
Zack Jones, MBA student, France
Ulrik Kautsky, SKB, Sweden
Jean-Pierre Lacroix, IRE-ELIT, Belgium
Candida Lean, National Nuclear Laboratory, UK
Joseph Magill, JRC/Nucleonica, Germany
Steve Mihok, Canadian Nuclear Commission (CNSC), Canada
Tommi Renvall, STUK, Finland
Sylvian Saint-Pierre, World Nuclear Association
Malgorzata Sneve, Norwegian Radiation Protection Authority, Norway
Peter Stegnar, NATO/Slovenia
Synnove Sundell-Bergmann, Vattenfall, Sweden
Jamie Towne, World Nuclear Association
Jari Tuunanen, European Nuclear Society

STAR Participants

Clare Bradshaw, Stockholm University, Sweden
Tom Hinton, IRSN, France
Tarja Ikäheimonen, STUK, Finland
Ole Christian Lind, UMB, Norway
Juan Carlos Mora, CIEMAT, Spain
Deborah Oughton, UMB, Norway
Iisa Outola, STUK, Finland
Almudena Real, CIEMAT, Spain
Brit Salbu, UMB, Norway
Martin Steiner, GfS, Germany
Lindis Skipperud, UMB, Norway
Hildegarde Vandenhove, SCK•CEN, Belgium

Supply Workshop Participants

Stakeholders

Francois Brechignac, International Union of Radioecologists
David Bytwerk, Oregon State University and NCore, USA
Simon Carroll, IUR and SSM, Sweden
Michael Christie, Stockholm University, Sweden
Helmut Fischer, University of Bremen, Germany
Eduardo Gallego, Madrid University, Spain and NERIS EU project
Hemda Garelick, Middlesex University, UK
Neil Hyatt, Sheffield University, UK
Kym Jarvis, Viridian/Empower Project, UK
Jan John, EU-CINCH project, Czech Republic
Jan Christian Kaiser, Helmholtzz Institute, Germany
Candida Lean, National Nuclear Laboratory, UK
Carmel Mothersill, McMaster University, Canada
Nicholas Priest, EURAC/ENEN and AECL, Canada
Colin Seymour, McMaster University Canada
Svein Sjøberg, University of Oslo, Norway
Graham Smith, BIOPROTA Technical Secretariat
Siiri Suursoo, Department of Nuclear Physics, Estonia
Peter Stegnar, NATO/Slovenia
Synnove Sundell-Bergmann, Vattenfall, Sweden
Christian Tamponniet IRSN and University of Marseilles, France
Jamie Towne, World Nuclear Association
Jon Petter Omtvedt, University of Oslo and CINCH EU-project
Susan Parry, Imperial College and UK Empower project
Andrzej Wojcik, Stockholm University and DoReMi
Michael Wood, Salford University, UK

STAR Participants

Cath Barnett, CEH, UK
Clare Bradshaw, Stockholm University, Sweden
Michele Coeck, SCK•CEN, Belgium
Tom Hinton, IRSN, France
Elis Holm, NRPA, Norway
Deborah Oughton, UMB, Norway
Sabera Patel, CEH, UK
Almudena Real, CIEMAT, Spain
Brit Salbu, UMB, Norway
Lindis Skipperud, UMB, Norway

AGENDA SUPPLY WORKSHOP: WHAT SKILLS ARE EMPOYERS LOOKING FOR IN THEIR WORKFORCE?

STUK, Helsinki, Finland, 19-20th May 2011

19th May am *Chair: Deborah Oughton, UMB*

0900: Welcome: Tarja Ikäheimonen, STUK
Brief into to STAR project, WP6 and aim of workshop- Tom Hinton and Deborah Oughton

Session 1: Setting the scene: "What is the future likely to hold"; What are the drivers for recruitment from radioecology

Lecture 1: Nuclear Renaissance – Sylvain Saint Pierre, WNA
Lecture 2: Regulatory/institutional drivers – Malgorzata Sneve, NRPA
Introduction to Breakout Sessions

1030: Coffee and Breakout session 1

1200-1300 Lunch

19th May pm *Chair: Clare Bradshaw, Stockholm University*

1300: Plenary feedback session 1

Session 2: Needs and Future Challenges "What skills are the employers looking for"

Comment 1: Industry: Stephane Bourg, CEA; Ari Ikonen, Posiva
Comment 2: Government: Tim Jannik, DOE, NCoRE
Comment 3: Regulator/authority: Paul Dale, SEPA

1430: Coffee and Breakout Session 2
1600: Plenary feedback Session 2

1900: Workshop Dinner: Ravintola Lasipalatsi (Hosted by STAR)

20th May am *Chair: Almudena Real, CIEMAT*

0900: Session 3: Implementing Education and Training in the Workforce

Lecture 1: Nuclear engineering and training networks – Jan John, CINCH/ ENEN
Lecture 2: Dissemination – Nucleonica Joseph Magill, JRC

1000: Breakout session 3 and Coffee

1130: Plenary feedback *Chair: Brit Salbu, UMB*

1200 Summing up and future work

AGENDA DEMAND WORKSHOP: HOW TO PROVIDE THE BEST COURSES AND RECRUIT THE STRONGEST CANDIDATES?
Location: Voksenåsen, Oslo, Norway, 15th-16th November, 2011

15th November am *Chair: Deborah Oughton, UMB*

0900: Welcome

Brief into to the STAR project, WP6 and aim of workshop - Tom Hinton/Deborah Oughton

0910 Eye-Opener: Why don't they love us anymore? School childrens' perception of Science, Svein Sjøberg, UiO and ROSE project

0945: Session 1: Setting the scene: "What is radioecology?"

Radioecology in 2012, Francois Brechignac IUR

The EU Radioecology Education Initiative, Nick Priest EURAC/ENEN and AECL, Canada

Radioecology education in the US, David Bytwerk, Oregon State University and NCoRE

1045: Coffee and Breakout session 1 (Theme: Curriculum; course modules and syllabus; needs for MSc, PhD, worker training,...)

1230-1330 Lunch

15th November pm *Chair: Clare Bradshaw, Stockholm University*

1330: Plenary feedback session 1

1400: Session 2: How to do it: Teaching and Training in the 21st Century

Information and communication technology in teaching, Michael Christie, SU, Sweden

Distance and work based learning, Hemda Garlick, Middlesex University, UK

e-learning - experience from CINCH and radiochemistry Jon Petter Omtvedt, UiO

1500: Coffee and Breakout Session 2 (Theme: design of e-learning tools, facebook site, interactive webpage, ...)

1630: Plenary feedback Session 2

1900: Workshop Dinner: Voksenåsen (Hosted by STAR)

16th November am *Chair: Almudena Real, CIEMAT*

0900: Session 3: How to do it: Networking and Funding

EU education and training networks – Michèle Coeck, SCKCEN, ENTRAP II co-ordinator

The Nuclear First Doctoral Training Centre: Neil Hyatt, Sheffield University

Engaging with Industry: the Empower project: Kym Jarvis/Susan Parry, Viridian

The New European credit system, Jan John

1015: Breakout session 3 and Coffee (Theme: Sustaining the nuclear education and training platform)

1200: Plenary feedback *Chair: Brit Salbu, UMB*

1230 Summing up and future work

Workshop Close

1300 Lunch