CINCH

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DELIVERABLE D4.6

Joint general purpose education/training course in Radioecology

Lead Beneficiary: **UMB**

Due date of Deliverable: **M33** Finalised on: **29/01/2013**

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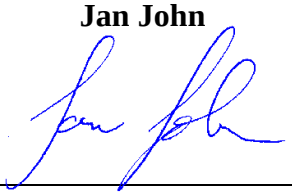
For the Lead Beneficiary	**Reviewed by Workpackage Leader**	**Approved by Coordinator**
Lindis Skipperud 	**Teodora Retegan** 	**Jan John** 

Start date of project: **01/02/2010** Duration: **36 Months**

Project Coordinator: Jan John

Project Coordinator Organisation: CTU in Prague Revision: (0)

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Dissemination Level		
PU	Public	**X**
RE	Restricted to a group specified by the partners of the CINCH project	
CO	Confidential, only for partners of the CINCH project	

EXECUTIVE SUMMARY

A two-week courses in radioecology, Radioecology (ECTS 5 points) derived from and given together with Experimental Radioecology (ECTS 10 points) were organized in parallel at the Norwegian University of Life Sciences, UMB, Aas from October 8th to October 19th 2012. The courses were aimed at MSc and PhD students. The 5 point Radioecology course attracted 4 students while 6 students followed the Experimental Radioecology (ECTS 10 points) course. The teachers were recruited among distinguished lecturers and scientists from Europe and Canada. All the course students were recruited from the Consortium members, of which 50% were local UMB students. Based on the course evaluation questionnaire, direct feedback from students as well as the experience of the teachers, the courses were successful in creating a good pedagogical atmosphere. The only criticism that was received related to the high intensity of the contact teaching hours. The accommodation of students in a private house and examinations at the student's home universities also were successful.

All information regarding trainees, teachers and lectures, including all presentations, are available for the students on the e-learning platform Fronter and for others on request.

This deliverable contributes to the following Work-Packages and Tasks:

WP 1
☐ TASK1.1 ☐ TASK1.2 ☐ TASK1.3 ☐ TASK1.4

WP 2
☐ TASK2.1 ☐ TASK2.2 ☐ TASK2.3

WP 3
☐ TASK3.1 ☐ TASK3.2 ☐ TASK3.3 ☐ TASK3.4

WP 4
☐ TASK4.1 ☐ TASK4.2 ☐ TASK4.3 ☐ TASK4.4
☐ TASK4.5 ☐ TASK4.6 ☒ TASK4.7

WP 5
☐ TASK5.1 ☐ TASK5.2 ☐ TASK5.3

WP 6
☐ TASK6.1 ☐ TASK6.2 ☐ TASK6.3 ☐ TASK6.4

OUTLINE

1 INTRODUCTION

Two radioecology courses, the new CINCH course in Radioecology (ECTS 5 points) together with Experimental Radioecology (ECTS 10 points), were arranged in parallel at Norwegian University for Life Sciences, UMB, in Aas, Norway, during 8-19th October 2012. The course module in Radioecology is intended to provide insight into the relevance of applied radiochemistry, linking nuclear/radiological sources to ecosystem transport, biological effects and risk evaluation. The course modules were given as intensive courses over 2 weeks each containing lectures, laboratory exercises, laboratory demonstrations and a case study.

Among the 4 students that participated in the Radioecology (ECTS 5 points) course, two were from the UH and one each from UiO and CTU.

Lectures were given by six internal UMB teachers and 6 external teachers from University College Dublin, Ireland; McMaster University, Canada; IRSN, France; CTU, Czech Republic; Jožef Stefan Institute, Slovenia; NRPA, Norway. A case study dealing with preparedness and countermeasures was arranged by teachers from UMB/NRPA. Furthermore, 3 technical staff from UMB, Aas supervised laboratory exercises while 1 administrative staff helped organizing travel and accommodation for visiting teachers and students.

2 COURSE ORGANIZATION

The courses were organized in parallel over two week's intensive teaching. The basic outline was alternating between lectures, laboratory demonstrations and laboratory exercises. The theoretical part of the course consisted of 38 hours of lectures and a 4 hours case study (i.e. 42 contact teaching hours) whereas laboratory exercises (23.5 hours) and laboratory demonstrations (1.5 hours) totaled another 25 contact teaching hours.

The external teachers were invited to provide lectures on specific topics; they usually stayed only overnight, so that the costs were kept down. Internal teachers were drawn from the staff of Department of Plant and Environmental Sciences, UMB, Aas.

2.1 Daily organization

Morning session with lectures/laboratory exercises: 8:15-12:00 or 0915-1200

Lunch: 1200-13:15

Afternoon session with lectures/laboratory exercises: 13:15-16:00/1315-1700/1315-1800

For detailed description of course organization, see Appendix 1.

3 THEORETICAL PART

For the detailed description of content of each topic, see Appendix 1.

3.1 Sources: Past, present and future sources of radionuclides in the environment

This topic was covered by a 2 hour overview lecture and 2 hours dealing specifically with the Chernobyl and Fukushima accidents. The topic was also covered intrinsically in many other topic lectures. The teachers were Per Strand and Ole Christian Lind.

Content:

- Natural and anthropogenic sources
- Nuclear weapon testing
- Nuclear fuel cycle
- Nuclear accidents
    - Fukushima
    - Chernobyl
- Dumping of radioactive waste
- NORM/TENORM
- Orphan sources

3.2 Radiochemistry, Tracer techniques, NAA

This topic was covered by 3 hours of lectures. The teacher was Jan John.

3.3 Speciation of radionuclides in the environment - radioecological aspects

This topic was covered by 4 hours of lectures but was also covered intrinsically in many other topic lectures. The teachers were Brit Salbu and Ole Christian Lind.

Content:

- Definitions
- Physico-chemical forms
- Radioactive particles
- Speciation techniques
- Analytical strategies and techniques

3.4 NORM and TENORM

This topic was covered by 4 hours of lectures and calculation exercises. The teachers were Jelena Mrdakovic Popic and Peter Stegnar.

Content:

- Public health issues related to Radon
- Sources of contamination of NORM radionuclides with cases:
- NORM sites in Norway
- TENORM sites in Central Asia and Norway
- Dose calculations

3.5 Radioecology

This topic was covered by 12 hours of lectures but was also covered intrinsically in many other topic lectures. The teachers were Tom Hinton, Luis León Vintró, John Brittain, Lindis Skipperud and Ole Christian Lind (Introduction to laboratory exercise).

Content:

- Definitions, principles and challenges, including multiple stressors
- Terrestrial radioecology
    - Ecosystem transfer of radionuclides
    - Countermeasures
- Marine radioecology
- Freshwater radioecology

3.6 Advanced analytical techniques employed within radioecology

This topic was covered by 2 hours of lectures but was also covered intrinsically in many several other topic lectures. The teacher was Brit Salbu.

Content:

- Mass spectrometric (MS) techniques
    - AMS
    - ICP-MS
- Micro-analytical techniques
    - Electron microscopy with x-ray microanalysis
    - Synchrotron based x-ray micro- and nanobeam techniques
    - TOF-SIMS
    - LA-ICPMS
- Fractionation techniques combined with MS techniques

3.7 Biological effects

This topic was covered by 5 hours of lectures. The teachers were Deborah Oughton and Carmel Mothersill.

Content:

- Biological effects of ionizing radiation to man and non-human biota
    - Principles
    - Mechanisms
    - Biomarkers including bystander effects
- Assessing impacts of ionizing radiation to non-human biota
- Introduction to Erica assessment tool

3.8 Modeling within radioecology

This topic was covered by 2 hours of lectures but was also covered in lectures on Fresh water radioecology and Marine radioecology. The teacher was Mikhail Iosjpe.

Content:

- Dispersion of radionuclides
- Compartment (box) modelling

- Dose assessment

3.9 Nuclear preparedness and environmental security

This topic was covered by 2 hours of lectures and a 4 hours case study. The teachers were Brit Salbu, Per Strand and Ole Christian Lind.

Content:

- Radiation protection regulations at Campus Aas
- National preparedness
- Threat assessment
- Uncertainties
- Risks
- Management
- Concepts
- Environmental security

4 LABORATORY EXERCISES

Laboratory exercises (23.5 hours) supervised by Marit Pettersen, Merethe Kleiven and Tove Loftaas and demonstrations (electron microscopy; 1.5 hours) given by Ole Christian Lind consisted of 25 contact teaching hours. Laboratory exercises essentially consisted of 2 different mesocosm experiments including fresh water, sediments, biota (macroinvertebrates) and radioactive tracers (^{60}Co, ^{137}Cs). The students worked in groups of 3 or 4 and were trained in the determination of the following parameters:

- Kd
- BCF
- Water soluble, potentially bioavailable, reversibly and irreversibly sorbed as well as inert fractions using sequential extractions
- Percentage distribution of particulate fraction, dissolved fraction, colloidal fraction, low molecular fraction as well as cationic and anionic fractions of radionuclides by means of size and charge fractionation.

The students participating in the Experimental Radioecology course were obliged to submit an in-depth lab journal for which they received (marks; 25% of the total mark for the course), whereas the students participationg in the 5 credit Radioecology course, needed only submitting a relatively less exhaustive lab journal (not subjected to marks). All students, submitted good and in some cases very good lab reports and the learning outcome related to writing these reports seems to be quite high.

5 TERM PAPER

Students in the Experimental Radioecology course were also obliged to submit a 10-20 pages term paper on a prescribed subject and given title or on a self-elected subject and title.

6 FEEDBACK

Based on a questionnaire answered by 8 students on the final day of the course and on feedback from 6 students after the exam the students thought that the course was interesting (1.1 on a scale from 1 to 5 where 1 is best), relevant (1.1) and gave good learning benefits (1.3). The structure of the course was well set up. The presence of top specialists as teachers and a good mix of lectures and laboratory exercises were highlights of the course. Recommendations for potential improvements were specifically contended by 3 students: Reduce the intensity of the course somewhat, preferably by increasing the duration of the course. For questions and results, see appendix 2.

7 CONCLUSIONS

1) CINCH modular radioecology course were successfully held at UMB in Aas, Norway.
2) It was a two week course, consisting of 67 contact teaching hours.
3) The course was organized with the help of external teachers, giving lectures in their field of expertise.
4) The course had two main parts – theoretical part (42 hours) and laboratory exercises (25 hours).
5) Feedback from students and teachers was mainly positive.
6) Organization of exams outside campus Aas (UMB), which represented pioneering work, was successful thanks to the flexibility of the students, CINCH collaborating partners and the student office of UMB.
7) All information regarding trainees, teachers and lectures, including all presentations, are available on request.

APPENDICES

RADIOECOLOGY/EXPERIMENTAL RADIOECOLOGY

AUTUMN 2012

APPENDIX 1

0110
1889

NORWEGIAN UNIVERSITY OF LIFE SCIENCES DEPARTMENT OF PLANT AND ENVIRONMENTAL SCIENCES
ISOTOPE LABORATORY

FROM OLE CHRISTIAN LIND
DATE 01.02.2013

PROGRAMME FOR

CINCH RADIOECOLOGY COURSE AND

EXPERIMENTAL RADIOECOLOGY

2012

Radioecology 5 credits
Experimental Radioecology 10 credits

Lectures in the Isotope laboratory meeting room
Lab exercises at the Isotope laboratory
Lunch break usually between 1200-1315 (see detailed programme)

The module include the following:
Ca. 38 hours lectures, 4 hours case study
Laboratory practice (ca 25 hours) and submission of laboratory journal (counts ¼).
Submission of term paper (counts ¼).
Written exam in December (counts $^{2}/_{4}$).

Week	Date	Time	Activity	Subject	Lecturer/supervisor
40	Monday 8.10	08:15-10:00	LECTURE	Introduction: Speciation of radionuclides in the environment, radioecological aspects	Brit Salbu
		10:15-12:00		Radiochemistry, Tracer techniques, NAA	Jan John
		13:15-14:00			
		14:15-16:00		Advanced methods	Ole Christian Lind
		16:05-16:45		Introduction to laboratory exercise	Ole Christian Lind
	Tuesday 9.10	08:15-10:00	LAB	Start experiment: Kinetics, CF, Kd. Size- and charge fractionation	Marit Nandrup Pettersen/Merethe Kleiven/Tove Loftaas
		10:15-12:00	LECT URE	Sources; Past, present and future sources of radionuclides in the environment	Brit Salbu
		13:15-15:00	LAB	Kinetics, CF, Kd: 3-4 hrs measurement Size- and charge fractionation continue	Marit Nandrup Pettersen/Merethe Kleiven/Tove Loftaas
		15:15-16:00	LECT URE	NORM	Lindis Skipperud

	Wednesday 10.10	08:15–12:00 13:15-15:00	LAB	Sequential extractions, step 1-4 Kinetics, CF, Kd: ~24 hrs measurement	Marit Nandrup Pettersen/Merethe Kleiven/Tove Loftaas
		15:15-17:00	LECT URE	Nuclear accidents: Chernobyl and Fukushima accidents	Per Strand
	Thursday 11.10	08:15–12:00	LAB	Sequential extractions, step 5-6	Marit Nandrup Pettersen/Merethe Kleiven/Tove Loftaas
		14:15-17:00	LECT URE	Radioecology principles and challenges, including multiple stressors	Tom Hinton
	Friday 12.10	08:15-12:00	LAB	End kinetics, BC, Kd, ~70 hrs measurement Autoradiography Start depuration	Marit Nandrup Pettersen/Merethe Kleiven/Tove Loftaas
		13:15-15:00	LECT URE	Assessing impacts of ionizing radiation to non-human biota Introduction to Erica assessment tool	Deborah Oughton
		15:15-18:00	LECTUR E	Biological effects of ionizing radiation to man and non-human biota (principles, mechanisms, biomarkers)	Carmel Mothersill
41	Monday 15.10	09:15–11:30 12:15-15:00	LAB	End depuration. Size- and charge fractionations, ~96 hrs Autoradiography (read-out)	Marit Nandrup Pettersen/Merethe Kleiven/Tove Loftaas/Ole C. Lind
	Tuesday 16.10	08:15–10:00 10:15-12:00 + 13:15-14:00 14:15-17:00	LECTURE	Freshwater radioecology including modeling Radionuclides in the marine environment, including modeling Terrestrial radioecology including countermeasures	John Brittain Luis León Vintró Lindis Skipperud
	Wednesday 17.10	08:15–11:00	LAB	Electron microscopy/Particle identification and characterization	Ole C. Lind/Cato Wendel
		12:15–14:00 14:15-16:00	LECT URE	Radioactive particles/ Speciation Modeling within radioecology	Ole Christian Lind Mikhail Iosjpe
	Thursday 18.10	09:15–12:00 13:15-15:00	LECTU RE	NORM with emphasis on dose calculations Preparedness, Environmental security	Peter Stegnar Brit Salbu
	Friday 19.10	09:15-12:00 13:15-14:00 14:15-15:00	LECTURE	Case study: Nuclear preparedness Summary of case study Summary of KJM351	Per Strand/Ole C. Lind Per Strand/Ole C. Lind Brit Salbu/Ole C. Lind

Deadline for term paper will be 1 week before the written exam (date to be decided).

Friday 12.10	DELIVERABLE	Students obliged to present a title for their term paper (own choice or from list of suggested titles)	Ole Christian Lind Submission on Fronter/by e-mail
Date to be decided	DELIVERABLE	Report an elaborated outline including suggested main literature for their term paper	Ole Christian Lind Submission on Fronter/by e-mail
November 15th	DELIVERABLE	Deadline for submitting laboratory report	Ole Christian Lind Submission on Fronter/by e-mail
December 1st	DELIVERABLE	Deadline for submitting term paper	Ole Christian Lind Submission on Fronter/by e-mail
December 13th 14:00-17:30	EXAM		

Brit Salbu
Professor

Ole Christian Lind
Associate Professor

	Question 1	Answer 1 1 (R)	2 (R)	3 (eR)	4 (eR)	5 (eR)	6 (eR)	7 (eR)	8 (eR)	Average		R = Radioecology course eR = experimental Radioecology
1	I think that the subject content of the course so far has been interesting	1	2	1	1	1	1	1	1	1,1	Interesting=1	Not interesting =5
2	I think that the subject content of the course so far has been relevant	1	2	1	1	1		1	1	1,1	Relevant 1	Not relevant 5
3	I think that the subject content of the course so far has been difficult	3	3	4	3	2		3	3	3,0	Difficult 1	Easy 5
4	The literature in the course is easy to follow and understand	2	1	1	1	2	1	1	2	1,4	Easy 1	Not easy 5
5	The literature in the course is too extensive	4	2	3	3	2	1	1	3	2,4	Too extensive 1	Did not cover 5
6	Teaching was engaging	2	3	2	1	2	1	1	3	1,9	Engaging 1	Boring 5
7	Teaching was varied	2	2	2	2	1	1	2	4	2,0	Varied 1	Monotonous 5
8	Teaching stimulated own thinking	2	3	1	2	2	2	2	2	2,0	Yes 1	No 5
9	Teaching was well planned/prepared	2	1	2	1	2	2	2	2	1,8	Well planed/structured 1	Unstructured/indiscriminate 5
10	Teaching was well adjusted to syllabus	2	2	2	2	3	1	1	3	2,0	Well 1	Badly 5
11	Teaching gave good learning benefits	1	2	1	1	1	1	1	2	1,3	Good 1	Bad 5
12	Theory was well illustrated by practical examples	1	4	3	2	1	1	1	2	1,9	Well illustrated 1	Little use of practical examples 5
13	Lecturer's presentation of subject clarified objectives, aims and requirements	2	2	1	1	2	1	2	2	1,6	Yes 1	No 5
14	Lecturer's presentation of subject gave good opportunities for taking notes	2	1	1	2	3	1	1	4	1,9	Yes 1	No 5
15	Lecturer's presentation of subject encouraged questions	2	3	1	3	1	1	2	2	1,9	Yes 1	No 5
16	Lecturer's presentation of subject was too fast	3	3	3	3	3	2	2	3	2,8	Too fast 1	Too slow 5
17	Lecturer's presentation of subject: Relevant use of relevant tools	2	2	4	2	1	2	1	2	2,0	Yes 1	No 5
18	Overall I think the teaching was Good/Bad	3	2	1	1	1	1	1	3	1,6	Good 1	Bad 5
19	Value of practicals/exercises	3		4	3	4	5	4	5	4,0	Misuse of time 1	Indispensable 5
20	Workload of practicals/exercises	3	2	5	3	4	5	3	4	3,6	Too light workload 1	Too heavy workload 5
21	The course was generally diffficult/easy	3	4	3	2	1	3	3	2	2,6	Difficult 1	Easy 5
22	The course included much subject matter/littel subject matter	2	2	1	2	1	1	3	2	1,8	Much subject matter 1	Little subject matter 5
23	New subject matter/Too much overlapping with other courses	2	2	1	3	1	2	3		2,0	New subject matter 1	Too much overlappings 5
24	Course not satisfactory/Very satisfactory	4	3	5	5	5	5	5	4	4,5	Course not satisfactory 1	Very satisfactory 5
25	Students opinion: I prepare well for lessons/I don't prepare well for lessons	2	4	1	3	3	3	3	4	2,9	Well prepared 1	Not prepared 5
26	Students opinion: I'm active in the teaching situation	2	3	1	4	2	2	2		2,3	Active 1	Passive 5
27	Students opinion: I work a lot with subject after lesson	3	3	2	3	1	4	3	3	2,8	A lot 1	Not much 5
28	Students opinion: I work with other students in this subject	3	2	1	3	1	1	3	1	1,9	A lot 1	Not much 5
29	Students opinion: Satisfied with own efforts so far?	3	2	1	3	2	2	3	4	2,5	Very satisfied 1	Not satisfied 5