CINCH-II

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CINCH VET Courses Prospectus

Lead Beneficiary: **NNL**

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Authors:	Paul Scully (NNL), Alex Brown (NNL)

For the Lead Beneficiary	Reviewed by Workpackage Leader	Approved by Coordinator
Paul Scully	**Paul Scully**	**Jan John**

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RE	Restricted to a group specified by the partners of the CINCH project	
CO	Confidential, only for partners of the CINCH project	

Version control table

Version number	Date of issue	Author(s)	Brief description of changes made
1.0	9/6/15	A.Brown, P.Scully	Issue to Participants for Comment and Discussion at M24 Meeting, Helsinki
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Relevance

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

☐ ALL

WP 1

☐ Task 1.1 ☐ Task 1.2 ☐ Task 1.3 ☐ Task 1.4

WP 2

☒ Task 2.1 ☐ Task 2.2 ☐ Task 2.3 ☐ Task 2.4

WP 3

☐ Task 3.1 ☐ Task 3.2 ☐ Task 3.3 ☐ Task 3.4 ☐ Task 3.5

WP 4

☐ Task 4.1 ☐ Task 4.2 ☐ Task 4.3 ☐ Task 4.4

WP 5

☐ Task 5.1 ☐ Task 5.2 ☐ Task 5.3 ☐ Task 5.4

Project information

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Coordinator contact:	+420 224 358 228, jan.john@fjfi.cvut.cz
Administrative contact:	+420 245 008 599, cinch@evalion.cz
Online contacts:	http://www.cinch-project.eu/

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EXECUTIVE SUMMARY

The CINCH-II consortium aims at finding a way of meeting the nuclear chemistry postgraduate education training needs of the European Union. As part of this, the CINCH-II consortium has developed vocational and educational training (VET) courses which meet the needs of non-academic end users. This document acts as a prospectus describing each course and its aims, topics and some of what the student will learn.

CONTENT

1 INTRODUCTION: WHAT IS CINCH AND VET?

Coordination in education and training In Nuclear CHemistry (CINCH-II) is a consortium of partners across Europe which aims at bringing together the capabilities of the different partners in order to implement new courses and to find a way of meeting the nuclear chemistry postgraduate education training needs of the European Union.

As part of CINCH, a pan-European set of vocational and education training (VET) courses for participation by nuclear industry and research professionals are being prepared. These VET courses will be developed for the specific needs of non-academic end-users, for example employers, regulators etc. These needs were identified in a comprehensive review undertaken by the CINCH consortium. The VET courses described in the sections below will be developed and delivered by the following partners:

- Loughborough University (LU) - United Kingdom,
- Norwegian University of Life Sciences (NMBU) - Norway,
- The Atomic Energy and Alternative Energies Commission (CEA) - France,
- Chalmers University of Technology (Chalmers) - Sweden,
- Czech Technical University (CTU) - Czech Republic.

2 COURSES

Liquid Scintillation Counting (LU)

This course will cover a range of topics with a thorough overview of quenching including channel ratios method, colour quenching and quench correction by automatic external standard.

As well as the theoretical course, a practical element will be undertaken by the delegates. The course will primarily focus on two radioisotopes, C-14 and H-3. It will include the preparation of quenched C-14 and H-3 standards for use on the course, and as the course progresses, other isotopes such as P-32 and I-125 will be prepared in different matrices. In addition, more challenging samples will be investigated such as dual labelled samples. In the prepared samples, inhomogeneity and the effect of sample volume on counting efficiency will be looked at.

Field Work (LU)

The field work program will be based on the Mobile Environmental Laboratory (MEL) owned by Loughborough University's Radiochemistry Group. This content will focus on non-nuclear radioactively contaminated sites such as Needles Eye, Ravenglass and South Terras as well as those used by the oil and gas industry. Training and sampling techniques will be provided prior to practical experience and application of these techniques will be applied in the field. This will lead to in situ analysis using the MEL.

An Introduction to Radioisotope Techniques (LU)

This course will cover an introduction to nuclear chemistry and radiochemical techniques. As part of this, methods of measurement (i.e. liquid scintillation counting, gamma and alpha spectrometry) and statistics will be covered. Čerenkov will be also looked at along with purity, stability, hazards and quality control. Additional subject areas include applications in organic chemistry, radiochromatography, autoradiography, biology, analytical techniques and uses of ionising radiation. As well as the theoretical course, a considerable practical element will be undertaken by the delegates.

Environmental Radiobiology (NMBU)

The aim of the course is to give students an overview of the fundamental principles of radiobiology, but within the context of its effects on wildlife. As such, the course will cover both the history and the state-of-the-art of knowledge of the biological effects of radiation on humans. For non-human organisms, recent studies will be looked at which are challenging established radiobiology paradigms. This includes effects and endpoints of relevance for non-human organisms, ways in which radiobiology methods and biomarkers are being applied in ecological research, factors influencing radiosensitivity in different organisms, and ecological risk assessment. Finally, case studies will be located at, ecological research in Chernobyl and Fukushima, and laboratory work will be performed on biomarker analysis in model organisms.

ERICA Modelling Risk Assessment (NMBU)

The ERICA Integrated Approach combines exposure, dose and effect assessment with risk managerial considerations. A software programme called the ERICA Tool can be used to guide the user through the ERICA Integrated Approach's assessment process, the way it records information and the decisions it makes to assess radiological risk to terrestrial, freshwater and marine biota. The training course will cover the various elements of radiological environmental assessment by focusing on the use of the ERICA tool. In the course, students will learn how to use the ERICA Tool and gain a greater understanding of the impacts of radiation on wildlife. They will be able to understand the basis behind the contrasting results and interpretations on the effects of radiation on the environment.

Experimental Radioecology (NMBU)

The purpose of this course is to educate, train and equip participants with the basic knowledge of radioecology. Radioecology is the transport of radionuclides in the environment and how this could lead to a radiation dose to humans and ecosystems. Participants will conduct radioecological studies using tracer techniques, radiochemical separations and advanced measurement methods. The student will be taught the processes by which radionuclides are transported in the environment and also how they are retained. They will assess the environmental risks related to radioactive contamination and how it can be cleaned up.

Behaviour of Radionuclides in the Biosphere (CEA)

The aim of this course is to train and educate students on the behaviour of radionuclides if they are released into the environment. This behaviour is dependent on the source of the radionuclides and their speciation in different media. The course will also focus on an overview of human toxicology and radiotoxicology, and the impact of radionuclides on the environment whilst referring to guidance and recommendations given by international organisations. By the end of the course, students will have an overview of the field of radionuclide speciation applied to toxicology and the environment and the role of thermodynamic databases in making radionuclide speciation predictions.

Nuclear Fuel Fabrication (CHALMERS)

This course will discuss the sol-gel process for the production of uranium oxide fuel. The sol-gel process offers numerous advantages over what is currently used today (powder processing). One of these is that it eliminates various hazards related to the handling of radioactive powders. In this course, students will learn how solid microspheres (a gel) are formed from a sol gel and the processes that occur to the gel after it has been formed. These processes involve calcination to remove unwanted chemicals, formation of pellets and sintering. Following this, fuel characterisation methods will be discussed for example x-ray diffraction and scanning electron microscopy. To put the theory in practise, students will then participate in labs to perform the sol-gel process and characterise the pellets.

Plutonium Chemistry and Fuel Coolant Interaction (CHALMERS)

Plutonium has been called ‘the most complex metal, a physicist’s dream but an engineer’s nightmare’, and this course will discuss this complex metal in detail. It will start with an introduction to plutonium, its history and its place in nature. Students will then learn about the nuclear properties of plutonium and the compounds that it can form. Once students are comfortable with the basics of plutonium chemistry, the plutonium production processes including solvent extraction (e.g. the PUREX, BUTEX and TLA processes) and co-precipitation (LiF3 and BiPO4 processes) will be explained along with how plutonium metal is prepared.

The next part of the course is for students to be able to understand the role, function and interaction of nuclear fuel and its coolant. This will involve a short description of the current commercial reactors, the so-called Generation IV systems, and the different types of fuel and coolant used in these reactors. As well as this, the fission products released from the fuel into the coolant and detection of these fission products will be taught. Following the theory, experiments for the early detection of release will be taught along with some real experiments that have been done at Chalmers University.

Hands-on Training in Radiochemistry (CTU)

This course will be divided into two parts with a theoretical element and a practical element. The theoretical part will involve topics including the fundamentals of nuclear chemistry, radiation detection, separation methods and radioanalytical chemistry. This theoretical part will be integrated with the practical element. The practical element will involve learning the basics of working in a radiochemical laboratory, specifically the handling, preparation and dilution of radioactive samples. As well as this, the students will learn how to carry out a contamination survey and how to perform decontamination. Finally, students will learn how to use a variety of radiochemical techniques including liquid-liquid extraction of uranium and high resolution gamma ray spectroscopy. Overall, this course will be a fantastic introduction to the radiochemistry laboratory environment and some of the techniques used by radiochemists.

Practical Exercises in Radioanalytical Methods (CTU)

This course will start with a theoretical course which will be in two parts. The first part will be a discussion of the principles of key radioanalytical methods including the determination of the solubility constant, isotope dilution analysis and x-ray fluorescence. The second part will be determination of various radionuclides in the environment, and the completion of remotely operated RoboLab exercises. Once the students are familiar with the theory, the course will move to the practical exercises. The practical exercises will involve the use of a variety of radioanalytical methods for example the determination of uranium by neutron activation analysis and plutonium determination by alpha spectrometry. By the end of the course, it is thought the student will have a fundamental understanding of many radioanalytical techniques and how they are applied in the laboratory.

3 CONCLUSIONS

This document has produced a prospectus which describes the various VET courses that have been developed by the CINCH-II consortium. A non-academic end user reading this prospectus would know what VET courses are offered by CINCH-II and what the aims, topics and some of the benefits doing these courses are.