GENTLE
Graduate and Executive Nuclear Training and Lifelong Education

Starts on
1st of June
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Professional Education on Nuclear Energy

In the ever-changing European and global energy sectors, one thing remains constant: the interest in nuclear power. This interest can be found not only in numerous developed countries, among which several EU Member States, but also in an increasing number of emerging/developing economies which have started to take the potential of nuclear power seriously into account. As a result, the demand for highly educated nuclear engineers and scientists in industry, research, technical safety and governmental organisations is increasing. A highly skilled and up-to-date workforce plays a crucial role in responsibly maintaining the civil nuclear reactor fleet and decommissioning obsolete plants. In addition to this, it is imperative to involve a well-educated workforce in designing and building new nuclear infrastructure and in dealing with radioactive wastes.

Professional Education on Nuclear Energy

Therefore high quality education and training for workforce is essential for the future of the nuclear power sector. In an effort to stimulate and coordinate training in this field, the European Commission has recently brought together 11 leading academic and research institutions in Europe and a range of other stakeholders to create a sustainable lifelong training programme in the field of nuclear fission technology. This co-called GENTLE network offers professionals the opportunity to enrol in the Professional Education on Nuclear Energy, a unique programme designed by Europe's leading experts to meet the needs of nuclear industries, research and technical safety organisations.

An educated, well-trained workforce is essential for the future of the nuclear power sector.

Expertise

The GENTLE network that coordinates the course consist of Delft University of Technology (The Netherlands), Budapest University of Technology (Hungary), the CIRTEN interuniversity consortium for technological nuclear research (Italy), Karlsruhe Institute of Technology (Germany), Technical University of Madrid (Spain), The Belgian Nuclear Research Centre SCK•CEN (Belgium), The University of Manchester (UK), Paul Scherrer Institute (Switzerland), University of Tartu (Estonia), Lappeenranta University of Technology (Finland) and the Joint Research Centre of the European Commission. Learn more about the GENLTE network on gentleproject.eu.

Benefits

- Several large nuclear organisations support the course; participants have the opportunity to create links with the top employers in the nuclear industry.
- Eleven leading European institutes contribute to the curriculum, all supplying their unique specialism.
- The scope of the programme is truly international, with contact days in several countries.
- This modular programme covers all base theoretical and practical aspects regarding nuclear energy. Each module can be attended separately as its content covers the full scope of the module topic.
- The programme offers a hands-on approach, which includes extensive practical training.

Programme
Attending the full programme takes a little bit over one year and consists of five modular parts. All modules can also be followed sepertaly, if this suits your needs better. The first four modules aim to provide the participants with the suitable background and the specific knowledge about Nuclear Energy Systems and their main features through lectures, instructions and site visits. The fifth module is devoted to provide soft skills that are critical in the nuclear sector.

Topics
Module 1 – Understanding nuclear power - Delft University of Technology - June 2015
- Societal, economical and technical perspectives on nuclear energy
- Fundamentals of nuclear science, nuclear chemistry, thermal hydraulics, radiation protection and nuclear reactor physics
- Nuclear fuel cycle and waste management

- Module 2 – Producing energy with nuclear reactors - Karlsruhe Institute of Technology - October 2015
  - Principles of energy generation with nuclear reactors
  - LWR systems for energy generation and conversion including safety systems (PWR, VVER and BWR)
  - Operational aspects of PWR
  - Fundamentals of neutron physical and thermal hydraulic core design (principles, current methods, trends)
  - Dynamic behaviour of LWRs
  - One-day visit of the training reactor of IKE Stuttgart University (experiments, measurements)

Module 3 – Nuclear fuel from ore to waste - Joint Research Centre - Karlsruhe - February 2016
- Fundamentals of actinides chemistry and physics
- Where nuclear fuel comes from?
- How does it behave in the reactor?
- What to do with used fuel nuclear fuel afterwards?
- Existing technologies and future developments

Module 4 – Societal justification, safety and security of nuclear energy - SCK•CEN - Mol - April 2016
- Science, politics and ethics of nuclear technology assessment
- Nuclear safeguards and security aspects
- Nuclear safety aspects (deterministic and probabilistic approaches)
- Nuclear safety culture and methodologies for safety assessment
- Decommissioning of nuclear plants issues

Module 5 – Management systems - CIRTEN - Milan - June 2016
- Quality management principles
- Project management issues
- General soft skills
- Insights into the interaction processes with Safety Authorities and Regulatory Bodies

For more information about the specific dates of the modules we refer to the nuclear energy website.

Target group
The Professional Education on Nuclear Energy course is designed for professionals positioned in industry, consultancy companies, research organisations, (inter) governmental organisations and regulatory bodies. The programme is especially attractive for professionals (e.g. more than 3 years working experience) who have an MSc level degree in a technological/scientific area but who do not have a nuclear engineering background. The programme is open to qualified candidates from all over the world.

Study load
Every module has a workload of 8 ECTS credits. The modules have 80 face-to-face lecture hours combined with 140 hours for preparation, distant learning and homework assignments.

The total programme duration is little bit more than one year and upon successful completion of every individual module, you will receive a certification.

Tuition fee
In 2015 the programme will be offered for the introductory price of € 18,000.00 per participant for the complete programme. Individual modules can be attended individually for a price of € 3,600.00 per module.

These tuition fees cover all necessary costs; the complete study programme, books, access to student facilities, excursions, hotel and all the meals for the programme duration. (Travel arrangements to and from the lecture locations are not included).

www.nuclearenergy.education

You will visit 5 nuclear institutes

The Professional Education on Nuclear Energy offers you inside knowledge from 11 leading nuclear research institutes in Europe. You will have the extraordinary opportunity to visit 5 nuclear centres of expertise and learn firsthand about nuclear energy systems. The remaining partners will join you in these 5 locations to give you the best nuclear education possible.
Module 1 takes place at the Reactor Institute Delft (RID) at Delft University of Technology. Here you will visit a pool-type nuclear reactor, built specifically as a source of neutrons and positrons for fundamental and applied scientific research into areas such as health and sustainable energy. During Module 2, held at the Institute for Nuclear Waste Disposal (INE) of the Karlsruhe Institute of Technology, you will experience facilities to study the geochemical aspects of the long-term safety of nuclear waste disposal, equipped for working with radionuclides of all types including reactor fuels and alpha emitters. Module 3 is led by the JRC Institute for Transuranium Elements (ITU) in Karlsruhe, which is an inspiring location as its laboratories are equipped to deal with all stages of the fuel cycle. Module 4 is held at the Belgian Nuclear Research Centre (SCK•CEN), home to three operational research reactors, one in the process of being decommissioned and an underground laboratory dedicated to the study of potential geological host formations for long-lived and highly active nuclear waste. Finally, Module 5 takes place in Milan at CIRTEN, the joint centre of nuclear expertise of 6 universities in Italy, where you will learn everything about nuclear management systems.

Stakeholders

The stakeholders are in dialogue with the partners to difine the programme content. The stakeholders involved are AREVA (France), CNU (Romania), Eesti Energia (Estonia), ENEN (France), ENS (Belgium), FORATOM (France), NNL (UK), NRG (Netherlands), NUGENIA, SNETP (France), TVO (Finland), Urenco (Netherlands), Westinghouse (Sweden).

Partners

The following partners contribute to the Professional Education on Nuclear Energy programme.

TU Delft · European Commission · Universidad Politécnica de Madrid · SCK•CEN · SCK•CEN ACADEMY FOR NUCLEAR SCIENCE AND TECHNOLOGY · Lappeenranta University of Technology · CIRTEN Consorzio Interuniversitario per la Ricerca Tecnologica Nucleare · MŰEGYETEM 1782 · MANCHESTER 1824 The University of Manchester Dalton Nuclear Institute · KIT Karlsruhe Institute of Technology · Tartu Ülikool Universitas Tartuensis 1632 · Paul Scherrer Institut PSI

Contact

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21 - 04 - 2015

MODULE 3: Nuclear Fuel from Ore to Waste

Main coordinator: Joint Research Centre (JRC)
Teaching unit: Institute for Transuranium Elements
Dates: the 22th of February to the 4th of March 2016
ECTS credits: 8
Teaching language: English

Teaching staff:

Module manager: Stefaan van Winckel
Other teachers:

Main topics: Nuclear fuel cycle including behaviour of nuclear fuel during irradiation. The content includes exploration, mining, enrichment, irradiation, interim storage, reprocessing and geological disposal techniques.

Table 1: Course overview of Module 3 "Nuclear Fuel from Ore to Waste"

	MODULE 3: Nuclear Fuel from Ore to Waste	Hours	GENTLE Partners
1	Introduction	14	ITU
2	Front End	8	ITU
3	Service period	18	ITU
4	Back End	22	
5	Innovative Fuel Cycles	8	UMAN
6	Presentation Individual Learning Topic	8	
7	Learning test	2	

Teaching Methods *(same for every module):*
The lectures are built up from 4 parts. Every lecture hour asks 2-hour preparation, homework and examination of the student. 30minute preparation, 50minute lecture hours, 60minute study and 30minute assignment time.

MD.1. **Distant learning**. Prepare the subjects you are going to study at the course by watching online-lectures of your lectures at the location or reading some parts of the study literature (30 minutes per lecture hour).
Teachers need to prepare preparation work, online-lectures or pre-reading assignments. For examples of online-lectures see the You-Tube channel of Jan-Leen Kloosterman:
https://www.youtube.com/channel/UCi-0od2nkp7fUWZIUwTuO6Q
MD.2. **Lectures**. Learning in presentations by the Professors of Nuclear Energy about different topics, processes, methods, etc. The exposition is logically structured with the aim of providing a theory concepts, show the way to solve the different types of problems, point out the stages of the processes and standard procedures, indicate the correct way of using tools and calculations.
MD.2.1 **On-site visits**. Gain deeper and broader insight into the operation principles and other non-technical aspects (economical, environmental, societal, etc). See in real-life the things you are educated in the lectures.
MD.3. **Exam**. At the end of each programme week multiple-choice questionnaire will be filled out to test the knowledge received that week.
Teachers need to prepare one or two multiple-choice questions per lecture hour.
MD.4. **Homework assignment**. Given study material studied at home with an assignment that will be handed in through mail or e-mail with the module coordinator (per lecture hour: 60 minutes homework, 30 minutes assignment).
Teachers need to prepare assignments of 30 minutes per lecture hour.

Study book list:

- N. Tsoulfanidis, “The Nuclear Fuel Cycle”, ANS, 2013.
- TUDelft syllabus on the Fuel cycle.
- “Chapter 34: Nuclear Fuels”, Konings, Wiss and Guéneau (pdf, p147)
- “Fundamentel aspects of Nuclear Reactors Fuel Elements” by Olander (pdf, online)
- Waste Topics (INE) = following articles
- Bruno, J. and Ewing, R. C., 2006, “Spent nuclear fuel”, *Elements,* **2**, 343-349.
- Grambow, B., 2006, “nuclear waste glass – how durable?”, *Elements,* **2**, 357-363.
- Ewing, R. C., 2006, “The nuclear fuel cycle: a role for mineralogy and geochemistry”, *Elements,* **2**, 331-334.

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Table 2: Lecture overview of Module 3 "Nuclear Fuel from Ore to Waste"

	MODULE 3: **Nuclear Fuel from Ore to Waste**	**Hours**	**GENTLE Partners**
1	**Introduction:**	**14**	**ITU**
	Module Introduction (incl. historical overview)	2	
	Chemistry of the actinides	3	
	The solid state chemistry of UO2	2	
	Fundamentals of radiation effects (solids, liquids)	3	
	Radiological aspects of handling actinides	2	
	Glove box exercises	2	
2	**Front End:**	**8**	**ITU**
	Mining, exploration & conversion	2	
	Enrichment	2	
	Fuel fabrication (pellet, pin, element)	2	
	Visit to JRC-ITU fuel fabrication laboratories	2	
3	**Service period:**	**18**	**ITU**
	Irradiation behaviour of nuclear fuel (fuel, cladding)	6	
	Fuel management	2	
	Spent Fuel Behaviour	3	
	Visit to the JRC-ITU Hot Cells	3	
	Transuranus exercise	4	
4	**Back End:**	**22**	
	Reprocessing of Nuclear Fuel	3	ITU/INE
	Vitrification and high level waste	2	INE
	Excursion to the KIT vitrification laboratory	2	ITU/INE
	Fuel cycle waste treatment	2	INE
	Intermediate Storage	2	INE
	Geological disposal concepts	6	INE
	Actinide recycling	3	ITU
	Visit to HDB	2	ITU/INE
5	**Innovative Fuel Cycles:**	**8**	**UMAN**
	Thorium	2	
	Fast reactor fuels	2	
	High temperature reactors	2	
	Liquid fuel reactors	2	
6	**Presentation Individual Learning Topic**	**8**	
7	**Learning test**	**2**	
	TOTAL	**80**	

Table 3: Core learning outcomes in Module 3 "Nuclear Fuel from Ore to Waste"

	Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Topic 1: Introduction	K1. Describe the historical development of nuclear fuels. K2. Explain the chemistry of the actinide group elements with emphasis on the particularities of it. K3. Outline the crystallography and solid state chemistry of UO2. Explain the relation between structure and properties. K4. Discuss the capabilities and limitations of X-ray measurements. K5. Describe the interactions of charged particles with matter. K6. Describe the interactions of neutrons with matter. K7. Describe the interactions of gamma radiation with matter. K8. Illustrate and explain the radiological aspects of working with actinides.	S1. Apply the radiological aspects to the safe handling of actinides in glove-boxes. S2. Evaluate dosimetric information in terms of ICRP directives. S3. Compare the most effective shieldings for alpha, beta, gamma and neutron radiation.	C1. Manage autonomously the experimental lab work with actinides in glove-boxes in a safe manner. C2. Discuss with colleagues and the public about the radiological aspects of handling actinides / nuclear fuel.
Topic 2: Front End	K9. Describe the different steps from exploration for U-rich ore till yellow cake. K10. Explain and compare the different methods and technologies for isotopic enrichment of 235U. K11. Outline the different steps from yellow cake till fuel assembly. K12. List and analyse the most important fuel pellet specifications and product characteristics. K13. List and compare the different MOX fuel fabrication methods. K14. Discuss minor actinide fuels.	S4. Able to analyse critically a fuel fabrication report. S5. Assess and discuss possible fuel pellet defects.	C3. Discuss with fuel fabrication specialists the critical aspects of nuclear fuel fabrication.

	Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Topic 3: Service period	K15. Describe the microstructural evolution of nuclear fuel (UO2) under irradiation. K16. Describe and illustrate the impact of irradiation on the thermal properties of nuclear fuel (e.g. thermal conductivity, specific heat, dilatation coefficient, oxygen potential, etc…). K17. Describe and explain the impact of irradiation on the mechanical properties of nuclear fuel (e.g. Young's modulus, creep, …). K18. Discuss the High Burn-up Structure. K19. Outline nuclear fuel behaviour under extreme conditions. K20. Describe the impact of irradiation on LWR cladding performance. K21. List and explain the most important reactor fuel management issues. K22. Describe and explain the spent fuel behaviour (e.g. decay damage, thermal recovery, He accumulation, …).	S6. Assess and discuss a Post Irradiation Examination (PIE) report. S7. Use TRANSURANUS code calculations to predict fuel rod behaviour in normal conditions in LWR. S8. Use TRANSURANUS code calculations to predict fuel rod behaviour in accident conditions in LWR.	C4. Analyse and discuss with colleagues the in-pile and out-of-pile behaviour of nuclear fuel. C5. Discuss with PIE specialists the measurements and results of their research.
Topic 4: Back end	K23. Describe and illustrate the chemistry involved in the reprocessing of spent fuel. K24. Illustrate the recycling of fuels in potential P&T cycles. K25. Explain and compare the types and activity levels of waste from spent nuclear fuel treatment. K26. Outline the methods and technology for vitrification of high level waste. K27. Explain and compare intermediate storage techniques and the challenges, risks and benefits of the different methods. K28. Explain and justify the need for long-term disposal solutions. K29. Describe practice of recycling Pu in MOX fuel. K30. Understand alternatives to MOX for Pu consumption. K31. Understand the concept of using minor actinides as fuel.	S9. Compare and contrast ceramic waste-forms and cement waste-forms. S10. Assess and discuss risks and challenges of recycling actinides. S11. Compare the challenges, risks and benefits of the alternative geological disposal methods: - Near-field: waste packages and engineered zone, and their evolution, - Far-field: the rock options, their performance and interaction with the near-field. S12. Compare and discuss advantages and disadvantages of aqueous and pyrochemical reprocessing methods.	C6. Discuss the different waste management strategies (open cycle, closed cycle, …). C7. Communicate and discuss the various options for final geological disposal of nuclear waste. C8. Assess and discuss with colleagues the behaviour of radionuclides in the final geological disposal (near and far field).

	Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Topic 5: Innovative Fuel cycles	K32. Explain and illustrate benefits, risks and challenges of Thorium as a nuclear fuel. K33. Compare fuel characteristics of Fast Reactor (FR) fuel with LWR fuel. K34. Explain and compare benefits, risks and challenges of using FR fuels. K35. Explain and compare characteristics, benefits, risks and challenges of high temperature (HT) reactors. K36. Describe the fuel cycle for HT reactors. K37. Explain and compare characteristics, benefits, risks and challenges of liquid fuel reactors. K38. Describe the fuel cycle for liquid fuel reactors.	S13. Assess and discuss safety implications of low transuranic by-products in Thorium cycle S14. Compare the different innovative fuels cycles and evaluate the differences in each step of the nuclear fuel cycle.	C9. Debate with colleagues the pros and cons of innovative fuel cycles.
Presentation Individual Learning Topic		S15. Able to analyse critically the international literature within a given area of research. S16. Manage the acquisition, editing, analysis, interpretation, presentation and reporting of experimental data. S17. Communicate clearly results at local meetings.	C10. Assume responsibility to autonomously: • list a set of research objectives worthy of attention and which are realisable given the available resources. • write a literature review article concerning the area of interest. • realise the research objectives by integrating and applying knowledge and skills. • communicate clearly results to peers. • defend results in front of peers.

2016

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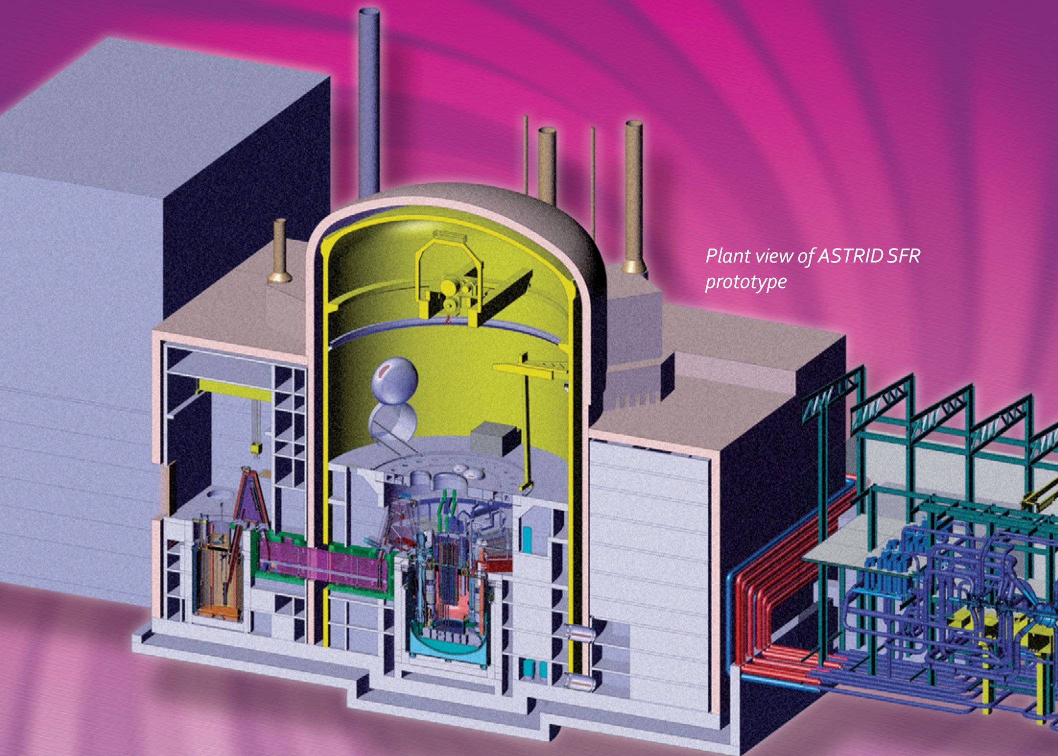

Plant view of ASTRID SFR prototype

Cadarache, Marcoule, Saclay - France

6 Doctoral-level Courses
in Nuclear Engineering
From January 11 to February 5, 2016

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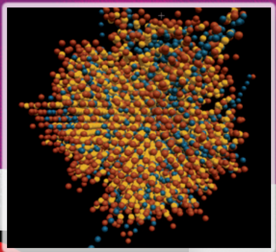
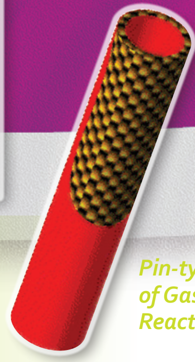
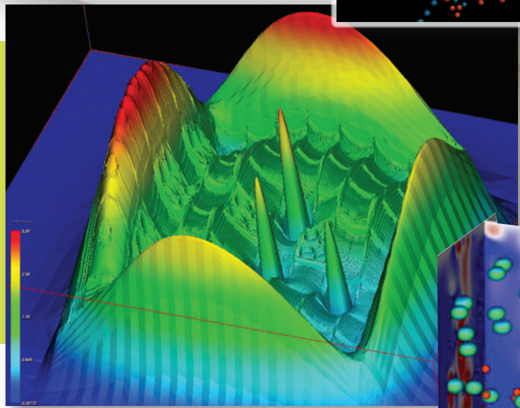
Computer simulation of displacement cascade

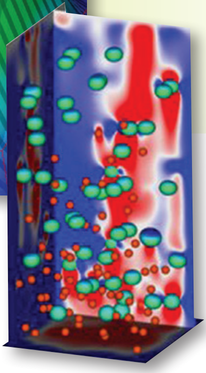




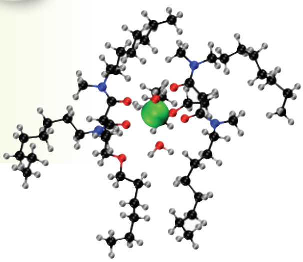
Pin-type fuel element of Gas Fast-cooled Reactor (GFR)



OSIRIS nuclear power distribution



Large scale bubble simulation



Actinide complex solvated by extraction molecule

ABOUT THE SCHOOL

- The National Institute for Nuclear Science and Technology (INSTN) is organizing the International School in Nuclear Engineering, aiming at promoting knowledge in the field of reactor physics and engineering at a high education level.

- The 2016 edition will offer 6 one-week advanced courses in nuclear engineering to be held in France (Cadarache, Marcoule, or Saclay), in January and February 2016.

- The courses are designed for young researchers, PhD students, post-doctorates and engineers, already having a Master of Science in nuclear engineering as a background. The courses will present the international state-of-the-art in the main topics of nuclear engineering: reactor core physics, thermal hydraulics, materials, fuels, fuel cycle, nuclear waste.
  3 ECTS will be awarded for each successfully completed course (one week).

- Lecturers are internationally known experts mostly from CEA, the leading research organisation in France for nuclear energy.

OUTLINE PROGRAMME OF COURSES

For each course technical visits of CEA facilities are planned.

Reactor Core Physics: Deterministic and Monte Carlo Methods

(C. Diop, A. Santamarina)

- Chain reaction and neutron balance
- Neutron slowing-down and resonance absorption, self-shielding modelling
- The neutron transport equation and calculation schemes: the steady-state integro-differential transport equation. The neutron diffusion equation... Verification & Validation of neutronics code package: process, sensitivity and uncertainty studies
- The Monte Carlo method for solving the transport equation
- Monte Carlo techniques: fixed source, variance reduction, criticality, perturbation calculations, adjoint calculation, applications to shielding

Thermal Hydraulics and Safety

(D. Bestion, J-M. Seiler, E. Studer)

- Basic modelling of two-phase flow
- Two-phase flow phenomena in LWRs
- Multi-scale approach of LWR thermal hydraulics
- System code modelling of reactor thermal hydraulics, including advanced modelling
- Simulation of LWR design basis accidents
- Application of two-phase CFD to reactor thermal hydraulic issues
- Multiphase phenomena and modelling of severe accidents in LWRs
- Hydrogen risk (production, dispersion, combustion, mitigation)

Materials for Nuclear Reactors, Fuels and Structures

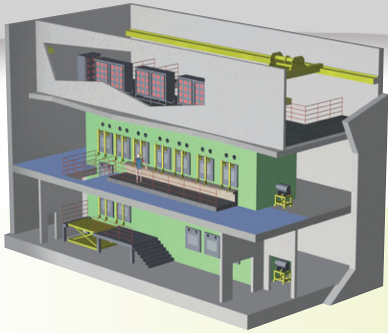
(J-L. Béchade, J-C. Brachet, F. Garrido)

- Mechanisms of irradiation damage: neutrons, photons, electrons
- Behaviour of materials under irradiation: ferritic steels for reactor pressure vessel, austenitic stainless steels for internals or fuel cladding (FBR), Zr alloys for fuel cladding and fuel assemblies (LWR)
- Fuel materials (UO_2, PuO_2): irradiation-induced effects
- Materials for high temperature conditions: SiC, ZrC, low swelling alloys
- Materials for fusion: low activation materials, resistance to high-energy neutrons, breading blankets

Nuclear Fuels for Light Water Reactors and Fast Reactors

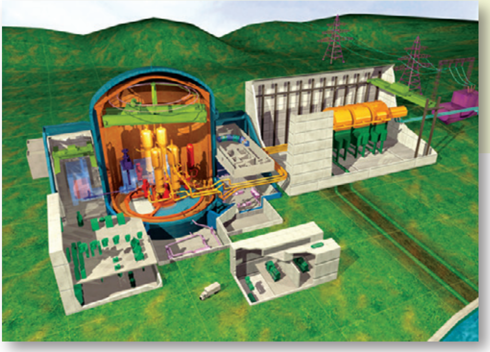
(D. Parrat, J. Noirot)

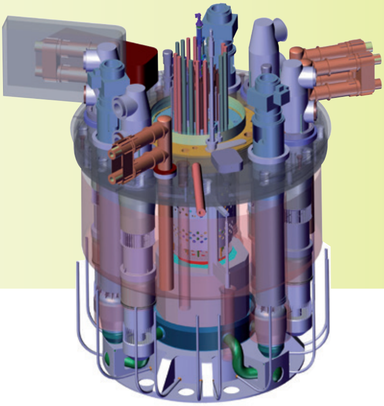
- Nuclear fuels fundamentals
- Fuel element thermal performance and temperature effects



ATALANTE facility

The EPR





Reactor vessel of the ASTRID SFR prototype

- Nuclear fuel behaviour under irradiation
- Main limiting phenomena in the different types of fuels
- Fuel behaviour during some off-normal conditions
- Modelling of fuel behaviour
- Fuel challenges for the future

Nuclear Fuel Cycle and Reprocessing

(Ch. Poinssot)

- Fuel cycle and spent fuel
- Fundamentals of fuel cycle: chemistry of actinides and fission products in solution
- PUREX spent fuel processing: fundamental knowledge and industrial process
- Minor actinide reprocessing
- Advanced fuel cycles

Nuclear Waste Management

(B. Bonin)

- General considerations on nuclear waste
- Waste conditioning
- Waste storage and disposal
- Perspectives

INFORMATION

- **Venue**
  The courses will be held at INSTN locations in Saclay (20 km southwest of Paris), Cadarache (40 km from Aix-en-Provence) and Marcoule (30 km from Orange).

- **Registration deadline**
  November 25, 2015

- **Registration fee**
  Professionals: 2 300 € for the first course, 1 200 € for each additional course.
  Students: 550 € for each course.
  CEA, ENEN member institutions: special rates.
  Fee covers lectures, documentation and lunches. Transportation will be organized from Aix-en-Provence and Orange (each at a specified location) to Cadarache and Marcoule respectively.

- **Contacts**
  Programme manager: Claude Renault - claude.renault@cea.fr
  Information: nuclear-school@cea.fr

Saclay

Thermal Hydraulics and Safety
January 11 to 15, 2016

Materials for Nuclear Reactors, Fuels and Structures
January 18 to 22, 2016

Contact for registration: Corinne Carreaux - corinne.carreaux@cea.fr

Cadarache

Reactor Core Physics: Deterministic and Monte Carlo Methods
January 11 to 15, 2016

Nuclear Fuels for Light Water Reactors and Fast Reactors
January 25 to 29, 2016

Contact for registration: Catherine Brosseron - catherine.brosseron@cea.fr

Marcoule

Nuclear Fuel Cycle and Reprocessing
January 25 to 29, 2016

Nuclear Waste Management
February 1 to 5, 2016

Contact for registration: Nathalie Nozerand - nathalie.nozerand@cea.fr

MAIN LECTURERS

Lecturers are experienced in teaching in several Masters of Science and Engineering programmes. They also supervise PhD students in their research activities.

Jean-Luc Béchade is Head of Material Microstructural Analysis Laboratory in the Department for Nuclear Materials at CEA Saclay. He is Professor at INSTN and Senior Expert in materials science, more precisely for nuclear materials with the specialty: metallurgy of zirconium alloys, determination of microstructures with advanced characterization techniques.

Dominique Bestion is Research Director at CEA. He has been working more than 20 years at the development and qualification of two-phase flow models for the CATHARE system code. He is now involved in the development of the NEPTUNE multi-scale thermal hydraulic platform as a coordinator of two-phase flow modelling activities. He is also coordinating thermal hydraulic activities of the NURESAFE European Project for a nuclear reactor multi-disciplinary and multi-scale software platform, and a Working Group of OECD-NEA for the application of CFD to nuclear safety.

Bernard Bonin is deputy scientific Director in the CEA's Nuclear Energy Division and Professor at INSTN. He has a background in fundamental research in high energy physics and materials physics. Between 1996 and 2000, he was Head of a Service for Research and Studies on Nuclear Waste, within CEA's Institute for Nuclear Protection and Safety. His studies then aimed at obtaining an overall view of the scientific basis for nuclear waste management. In 2000, he was appointed Assistant to the Director of R&D in COGEMA, in charge of the organisation of the R&D on the fuel cycle front-end, and on future nuclear energy systems.

Jean-Christophe Brachet is a CEA International Expert on nuclear materials and Professor at INSTN. His expertise covers physical metallurgy of chromium-rich ferritic-martensitic steels and zirconium alloys (in charge at CEA of the development and study of Cr coated Zr claddings for "Enhanced Accident Tolerant Fuel", behaviour in LOCA accidental conditions…). He authored more than 60 papers and participated to numerous international symposiums or workshops as lecturer or as chairman of specific sessions. He is inventor or co-inventor of 5 patents.

Cheikh M'Backe Diop is Research Director at CEA and Professor at INSTN, working at the Service of Reactor Studies and Applied Mathematics. He was Head of the Laboratory of Shielding Studies and Probability. He is co-author of a book on Radiation Protection and Nuclear Engineering. He teaches radiation shielding computational methods and the Monte Carlo method for simulating the particle transport in matter. He is the scientific manager of the Master Nuclear Reactor Physics and Engineering, which is run by the newly-created Paris-Saclay University.

Frederico Garrido is Professor of Materials Chemistry at the Université Paris-Sud, Orsay. He is an expert in the interaction of energetic particles with matter and radiation damage physics, especially applied to nuclear ceramic materials used as transmutation matrices (oxides and carbides). He has co-authored over 100 scientific papers in peer-reviewed journals. He became also a recipient of the Bronze Medal of the French National Centre for Scientific Research. In addition he is co-Director of the Master Nuclear Energy, which is run by the Paris-Saclay University.

Jean Noirot is International Expert at CEA. He has been working for more than 20 years in the field of nuclear fuel post-irradiation examination. With techniques going from gamma-scanning to micro-analyses, he has gained a wide experience on fuel behaviour, fast breeder reactor fuel, pressurized reactor fuel, including MOX, or dedicated experimentation on fuel in French or foreign test reactors. He has authored or co-authored more than 40 publications and book chapters.

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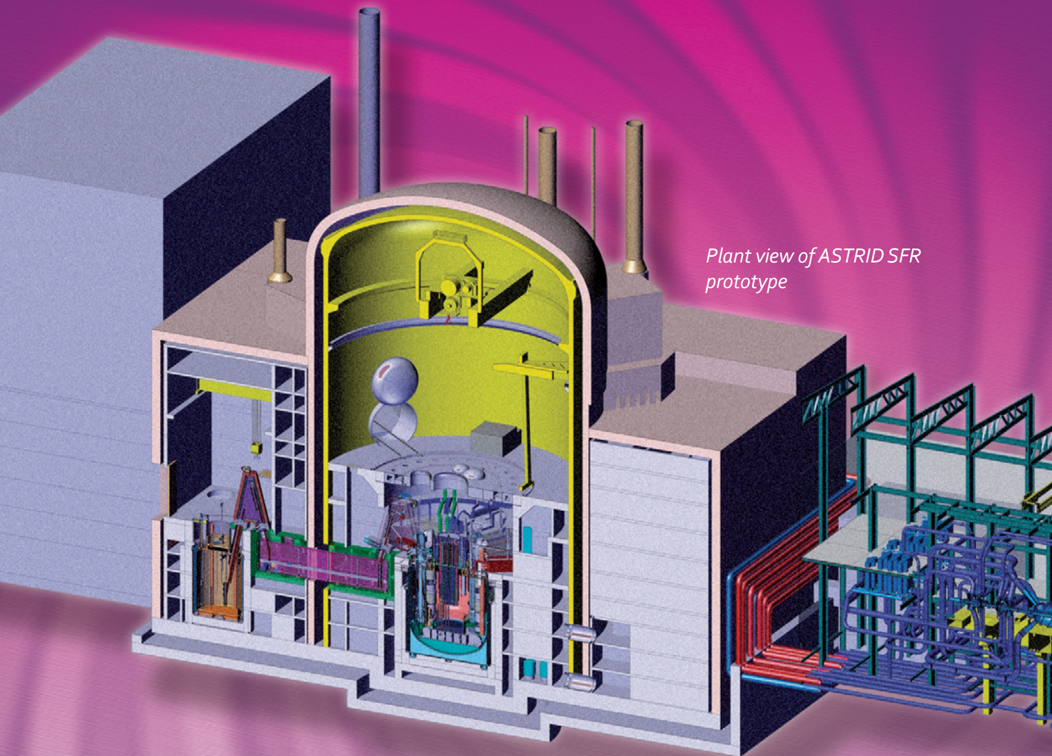

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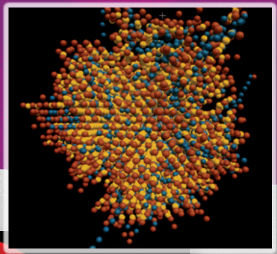

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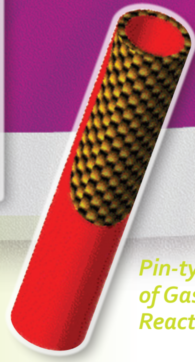

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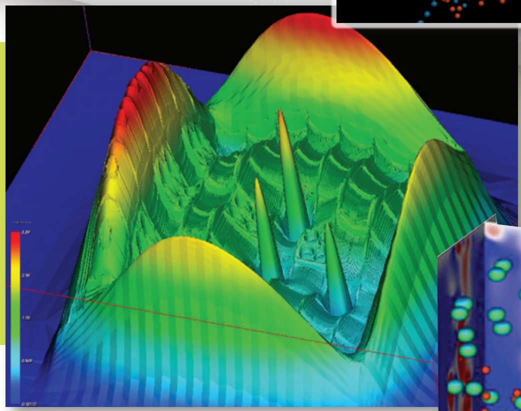

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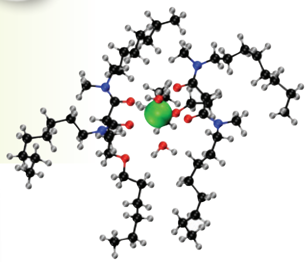
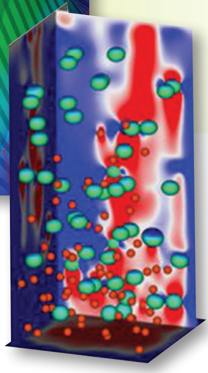


Actinide complex solvated by extraction molecule



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- The Monte Carlo method for solving the transport equation
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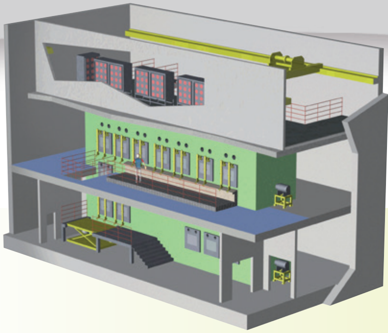

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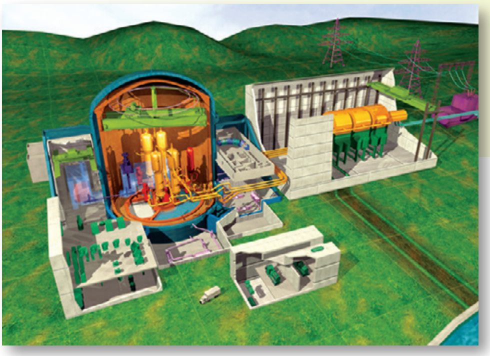

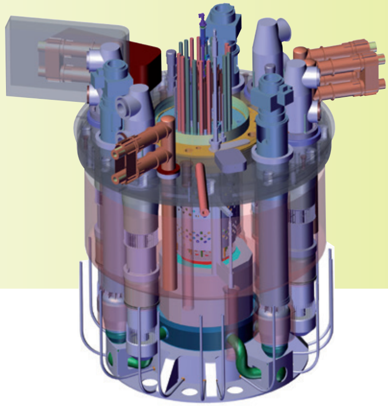

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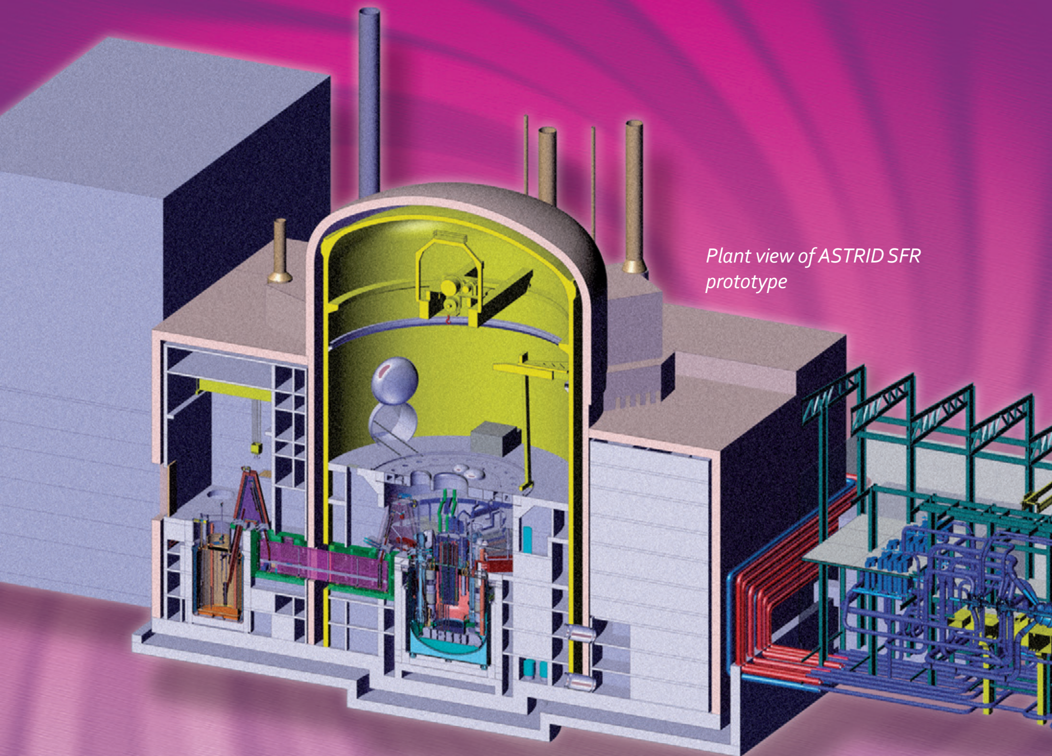

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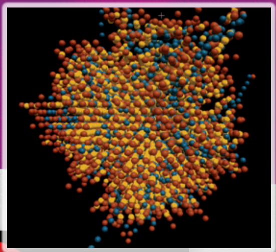

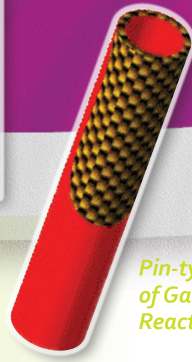

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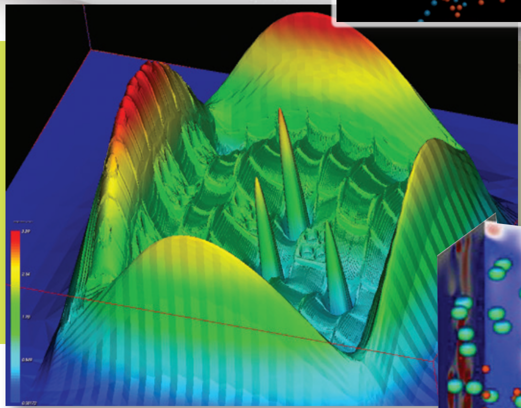

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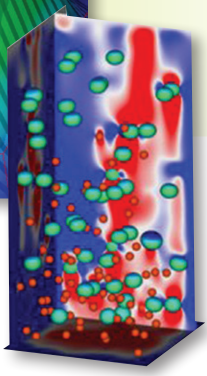

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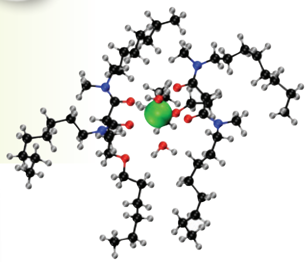

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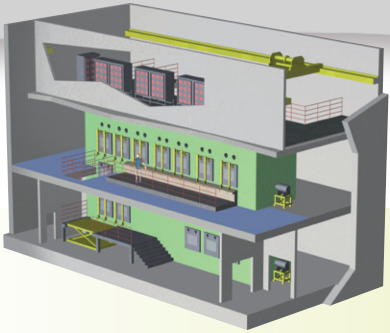

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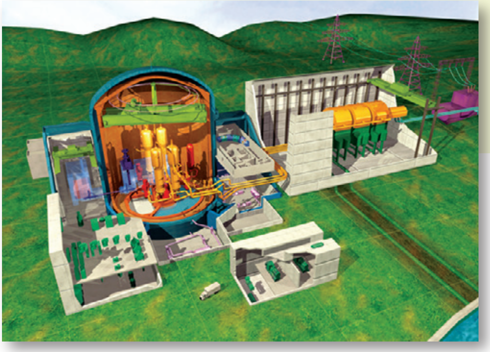

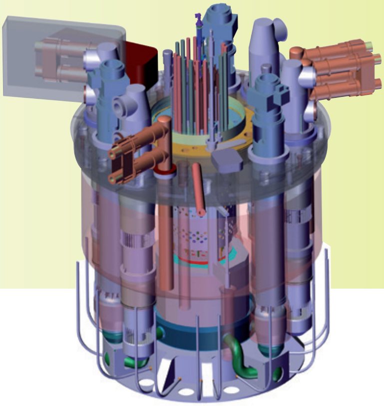

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2016

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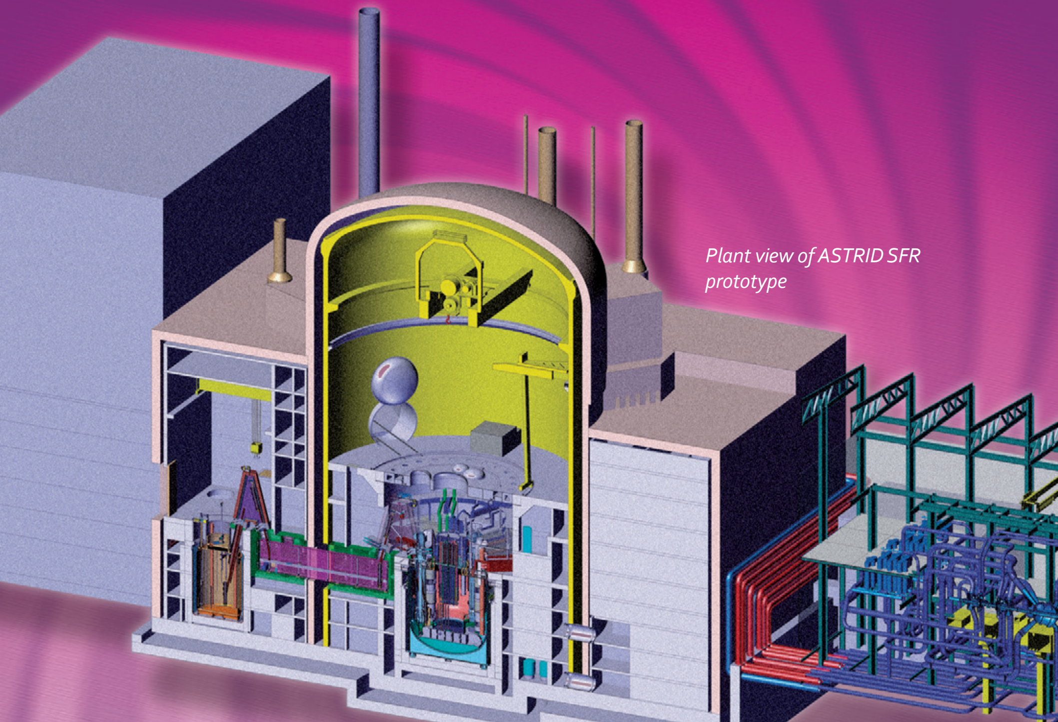

Plant view of ASTRID SFR prototype

Cadarache, Marcoule, Saclay - France

6 Doctoral-level Courses
in Nuclear Engineering
From January 11 to February 5, 2016

DE LA RECHERCHE À L'INDUSTRIE

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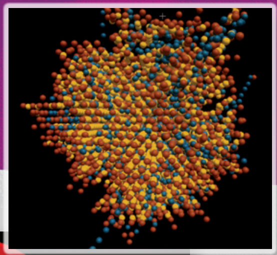
european nuclear education network

Please visit our website: http://www-instn.cea.fr



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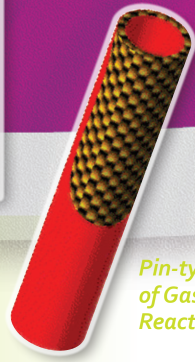
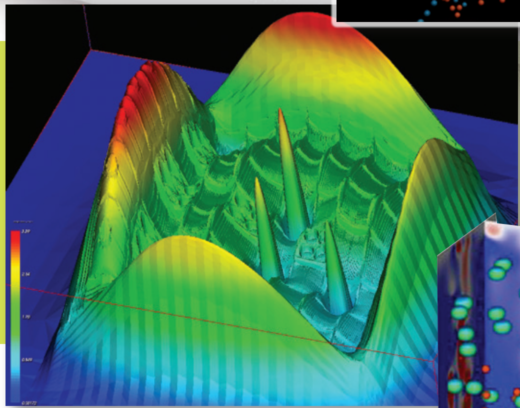


Pin-type fuel element of Gas Fast-cooled Reactor (GFR)



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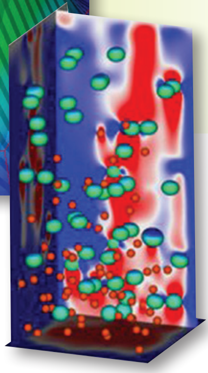

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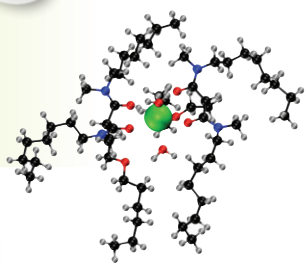

Actinide complex solvated by extraction molecule

ABOUT THE SCHOOL

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Reactor Core Physics: Deterministic and Monte Carlo Methods

(C. Diop, A. Santamarina)

- Chain reaction and neutron balance
- Neutron slowing-down and resonance absorption, self-shielding modelling
- The neutron transport equation and calculation schemes: the steady-state integro-differential transport equation. The neutron diffusion equation... Verification & Validation of neutronics code package: process, sensitivity and uncertainty studies
- The Monte Carlo method for solving the transport equation
- Monte Carlo techniques: fixed source, variance reduction, criticality, perturbation calculations, adjoint calculation, applications to shielding

Thermal Hydraulics and Safety

(D. Bestion, J-M. Seiler, E. Studer)

- Basic modelling of two-phase flow
- Two-phase flow phenomena in LWRs
- Multi-scale approach of LWR thermal hydraulics
- System code modelling of reactor thermal hydraulics, including advanced modelling
- Simulation of LWR design basis accidents
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- Mechanisms of irradiation damage: neutrons, photons, electrons
- Behaviour of materials under irradiation: ferritic steels for reactor pressure vessel, austenitic stainless steels for internals or fuel cladding (FBR), Zr alloys for fuel cladding and fuel assemblies (LWR)
- Fuel materials (UO_2, PuO_2): irradiation-induced effects
- Materials for high temperature conditions: SiC, ZrC, low swelling alloys
- Materials for fusion: low activation materials, resistance to high-energy neutrons, breading blankets

Nuclear Fuels for Light Water Reactors and Fast Reactors

(D. Parrat, J. Noirot)

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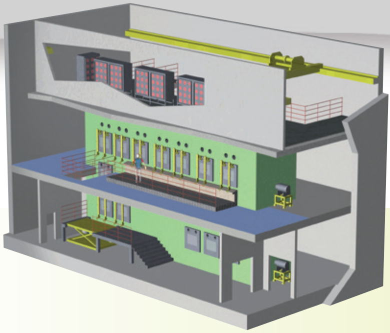

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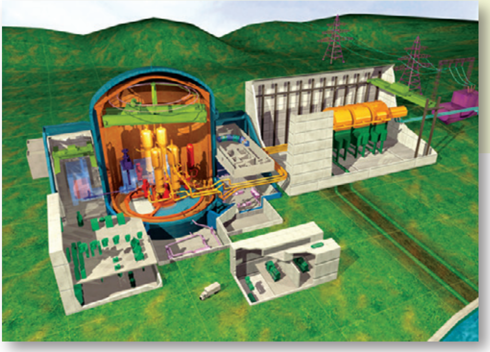

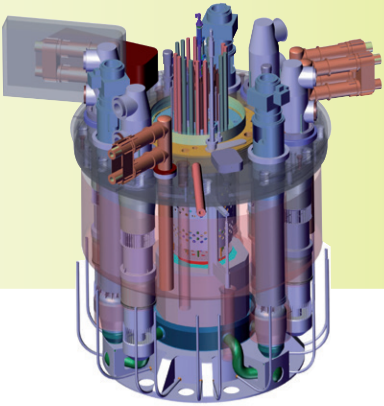

Reactor vessel of the ASTRID SFR prototype

- Nuclear fuel behaviour under irradiation
- Main limiting phenomena in the different types of fuels
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- Modelling of fuel behaviour
- Fuel challenges for the future

Nuclear Fuel Cycle and Reprocessing

(Ch. Poinssot)

- Fuel cycle and spent fuel
- Fundamentals of fuel cycle: chemistry of actinides and fission products in solution
- PUREX spent fuel processing: fundamental knowledge and industrial process
- Minor actinide reprocessing
- Advanced fuel cycles

Nuclear Waste Management

(B. Bonin)

- General considerations on nuclear waste
- Waste conditioning
- Waste storage and disposal
- Perspectives

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  CEA, ENEN member institutions: special rates.
  Fee covers lectures, documentation and lunches. Transportation will be organized from Aix-en-Provence and Orange (each at a specified location) to Cadarache and Marcoule respectively.

- **Contacts**
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Lecturers are experienced in teaching in several Masters of Science and Engineering programmes. They also supervise PhD students in their research activities.

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Dominique Bestion is Research Director at CEA. He has been working more than 20 years at the development and qualification of two-phase flow models for the CATHARE system code. He is now involved in the development of the NEPTUNE multi-scale thermal hydraulic platform as a coordinator of two-phase flow modelling activities. He is also coordinating thermal hydraulic activities of the NURESAFE European Project for a nuclear reactor multi-disciplinary and multi-scale software platform, and a Working Group of OECD-NEA for the application of CFD to nuclear safety.

Bernard Bonin is deputy scientific Director in the CEA's Nuclear Energy Division and Professor at INSTN. He has a background in fundamental research in high energy physics and materials physics. Between 1996 and 2000, he was Head of a Service for Research and Studies on Nuclear Waste, within CEA's Institute for Nuclear Protection and Safety. His studies then aimed at obtaining an overall view of the scientific basis for nuclear waste management. In 2000, he was appointed Assistant to the Director of R&D in COGEMA, in charge of the organisation of the R&D on the fuel cycle front-end, and on future nuclear energy systems.

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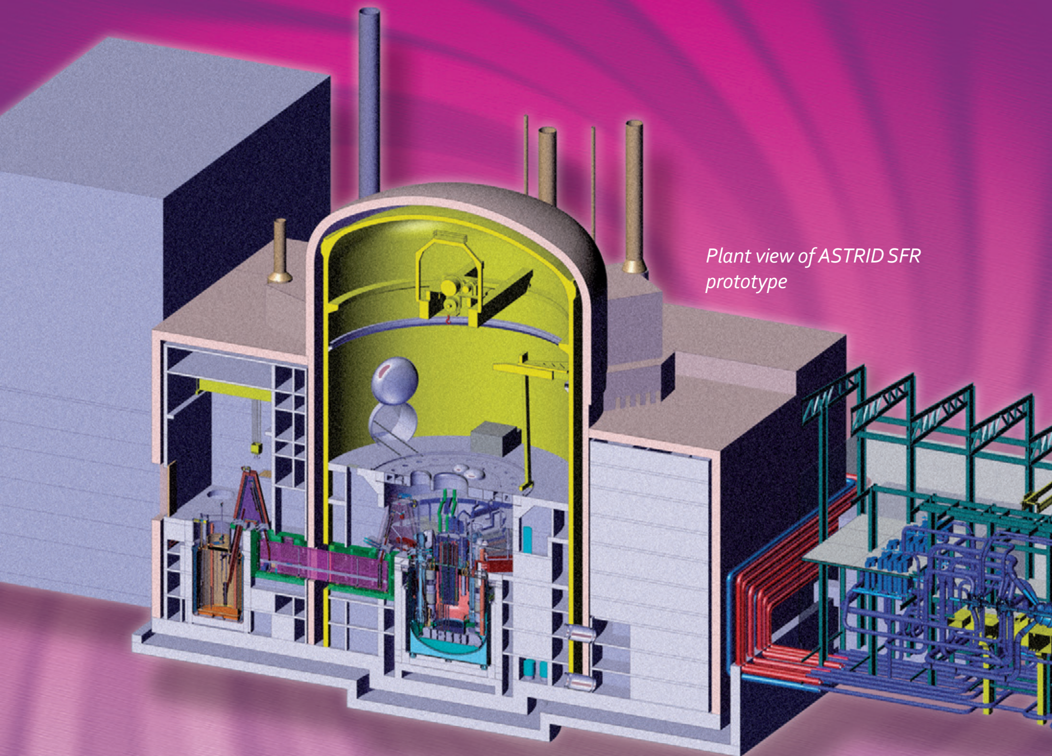

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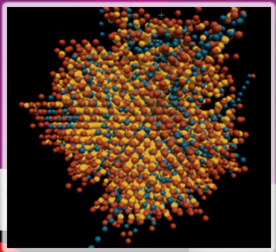

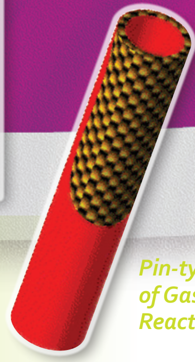

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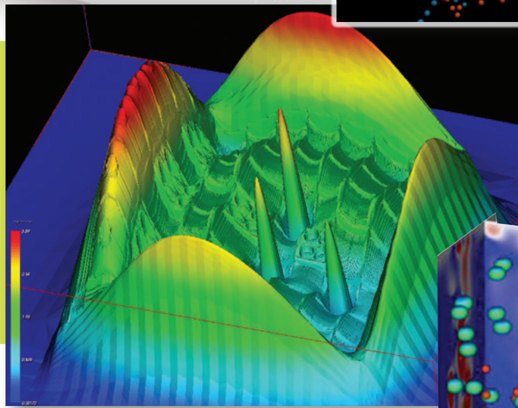

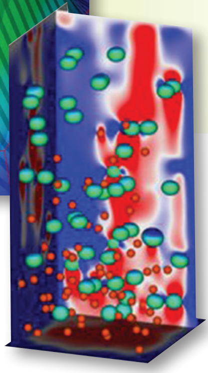

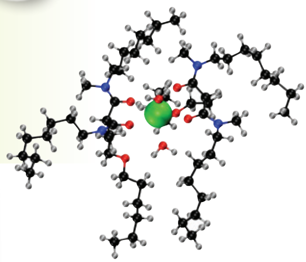

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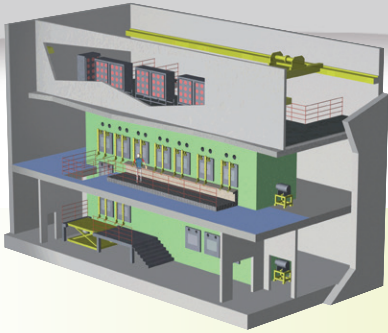

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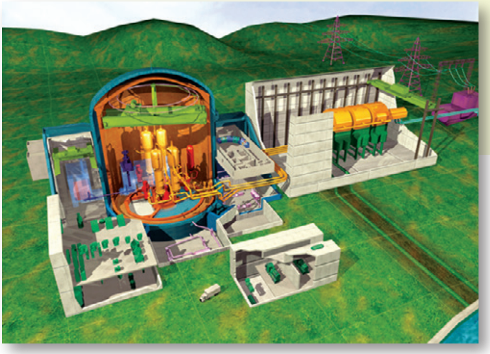

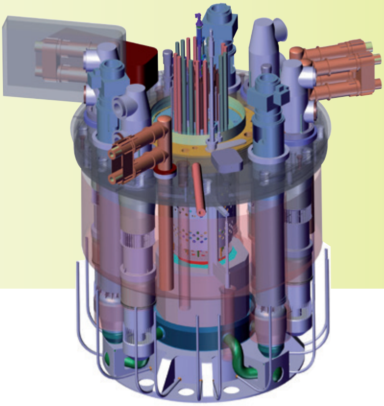

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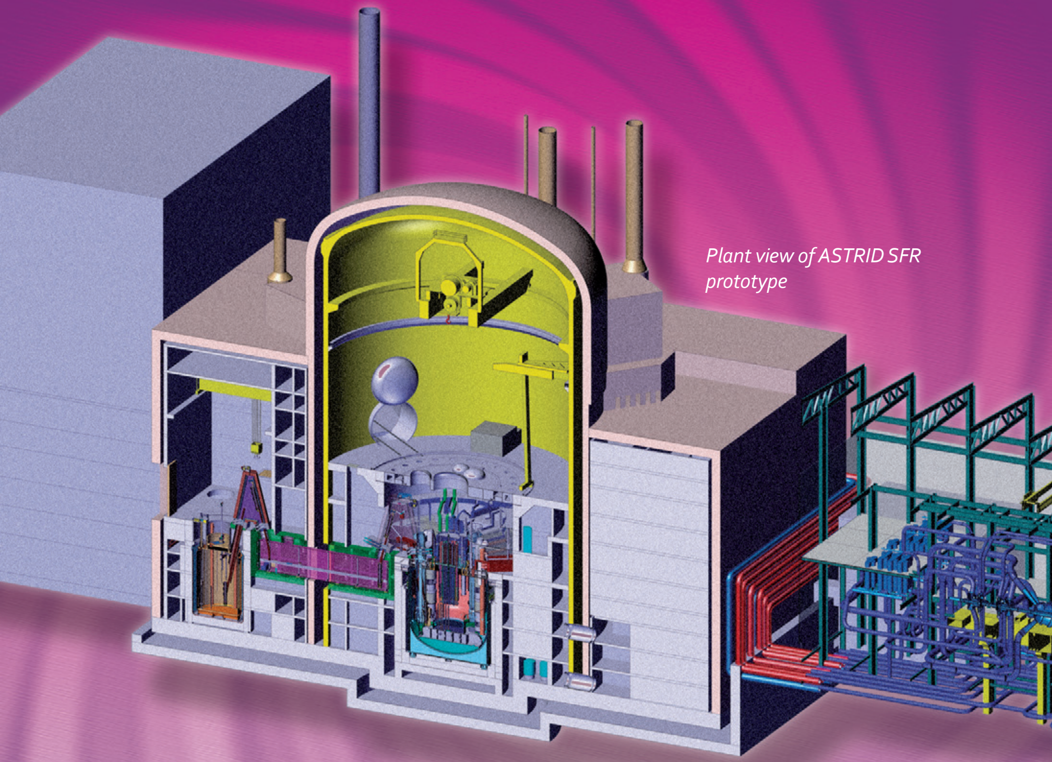

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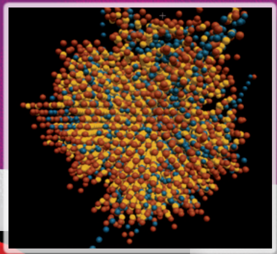

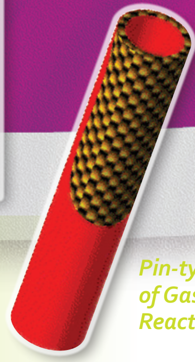

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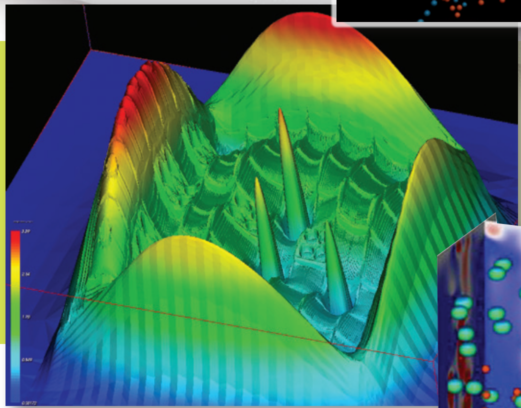
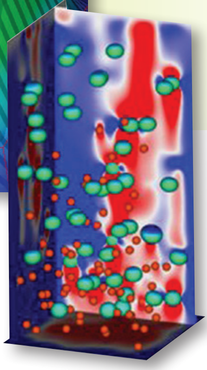
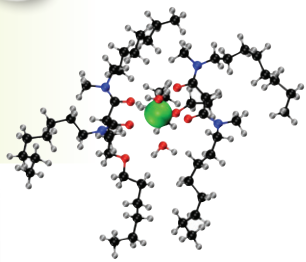






OSIRIS nuclear power distribution

Large scale bubble simulation

Actinide complex solvated by extraction molecule

ABOUT THE SCHOOL

- The National Institute for Nuclear Science and Technology (INSTN) is organizing the International School in Nuclear Engineering, aiming at promoting knowledge in the field of reactor physics and engineering at a high education level.

- The 2016 edition will offer 6 one-week advanced courses in nuclear engineering to be held in France (Cadarache, Marcoule, or Saclay), in January and February 2016.

- The courses are designed for young researchers, PhD students, post-doctorates and engineers, already having a Master of Science in nuclear engineering as a background. The courses will present the international state-of-the-art in the main topics of nuclear engineering: reactor core physics, thermal hydraulics, materials, fuels, fuel cycle, nuclear waste.
  3 ECTS will be awarded for each successfully completed course (one week).

- Lecturers are internationally known experts mostly from CEA, the leading research organisation in France for nuclear energy.

OUTLINE PROGRAMME OF COURSES

For each course technical visits of CEA facilities are planned.

Reactor Core Physics: Deterministic and Monte Carlo Methods

(C. Diop, A. Santamarina)

- Chain reaction and neutron balance
- Neutron slowing-down and resonance absorption, self-shielding modelling
- The neutron transport equation and calculation schemes: the steady-state integro-differential transport equation. The neutron diffusion equation… Verification & Validation of neutronics code package: process, sensitivity and uncertainty studies
- The Monte Carlo method for solving the transport equation
- Monte Carlo techniques: fixed source, variance reduction, criticality, perturbation calculations, adjoint calculation, applications to shielding

Thermal Hydraulics and Safety

(D. Bestion, J-M. Seiler, E. Studer)

- Basic modelling of two-phase flow
- Two-phase flow phenomena in LWRs
- Multi-scale approach of LWR thermal hydraulics
- System code modelling of reactor thermal hydraulics, including advanced modelling
- Simulation of LWR design basis accidents
- Application of two-phase CFD to reactor thermal hydraulic issues
- Multiphase phenomena and modelling of severe accidents in LWRs
- Hydrogen risk (production, dispersion, combustion, mitigation)

Materials for Nuclear Reactors, Fuels and Structures

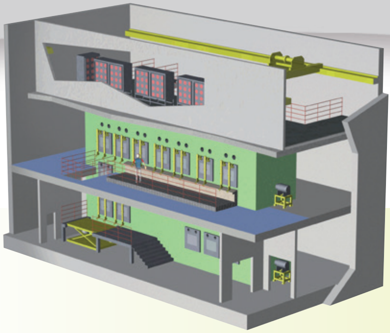
(J-L. Béchade, J-C. Brachet, F. Garrido)

- Mechanisms of irradiation damage: neutrons, photons, electrons
- Behaviour of materials under irradiation: ferritic steels for reactor pressure vessel, austenitic stainless steels for internals or fuel cladding (FBR), Zr alloys for fuel cladding and fuel assemblies (LWR)
- Fuel materials (UO_2, PuO_2): irradiation-induced effects
- Materials for high temperature conditions: SiC, ZrC, low swelling alloys
- Materials for fusion: low activation materials, resistance to high-energy neutrons, breading blankets

Nuclear Fuels for Light Water Reactors and Fast Reactors

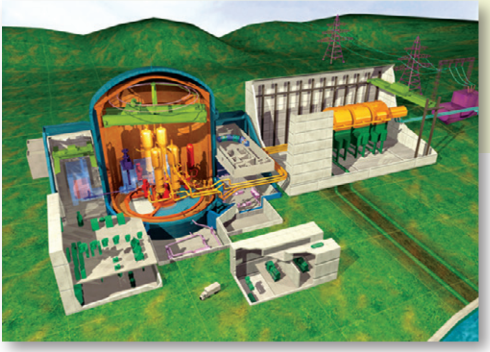
(D. Parrat, J. Noirot)

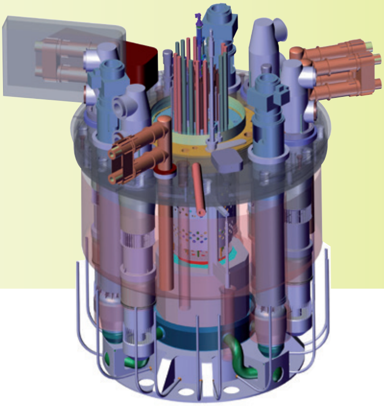
- Nuclear fuels fundamentals
- Fuel element thermal performance and temperature effects



ATALANTE facility

The EPR





Reactor vessel of the ASTRID SFR prototype

- Nuclear fuel behaviour under irradiation
- Main limiting phenomena in the different types of fuels
- Fuel behaviour during some off-normal conditions
- Modelling of fuel behaviour
- Fuel challenges for the future

Nuclear Fuel Cycle and Reprocessing

(Ch. Poinssot)

- Fuel cycle and spent fuel
- Fundamentals of fuel cycle: chemistry of actinides and fission products in solution
- PUREX spent fuel processing: fundamental knowledge and industrial process
- Minor actinide reprocessing
- Advanced fuel cycles

Nuclear Waste Management

(B. Bonin)

- General considerations on nuclear waste
- Waste conditioning
- Waste storage and disposal
- Perspectives

INFORMATION

- **Venue**
  The courses will be held at INSTN locations in Saclay (20 km southwest of Paris), Cadarache (40 km from Aix-en-Provence) and Marcoule (30 km from Orange).

- **Registration deadline**
  November 25, 2015

- **Registration fee**
  Professionals: 2 300 € for the first course, 1 200 € for each additional course.
  Students: 550 € for each course.
  CEA, ENEN member institutions: special rates.
  Fee covers lectures, documentation and lunches. Transportation will be organized from Aix-en-Provence and Orange (each at a specified location) to Cadarache and Marcoule respectively.

- **Contacts**
  Programme manager: Claude Renault - claude.renault@cea.fr
  Information: nuclear-school@cea.fr

Saclay

Thermal Hydraulics and Safety
January 11 to 15, 2016

Materials for Nuclear Reactors, Fuels and Structures
January 18 to 22, 2016

Contact for registration: Corinne Carreaux - corinne.carreaux@cea.fr

Cadarache

Reactor Core Physics: Deterministic and Monte Carlo Methods
January 11 to 15, 2016

Nuclear Fuels for Light Water Reactors and Fast Reactors
January 25 to 29, 2016

Contact for registration: Catherine Brosseron - catherine.brosseron@cea.fr

Marcoule

Nuclear Fuel Cycle and Reprocessing
January 25 to 29, 2016

Nuclear Waste Management
February 1 to 5, 2016

Contact for registration: Nathalie Nozerand - nathalie.nozerand@cea.fr

MAIN LECTURERS

Lecturers are experienced in teaching in several Masters of Science and Engineering programmes. They also supervise PhD students in their research activities.

Jean-Luc Béchade is Head of Material Microstructural Analysis Laboratory in the Department for Nuclear Materials at CEA Saclay. He is Professor at INSTN and Senior Expert in materials science, more precisely for nuclear materials with the specialty: metallurgy of zirconium alloys, determination of microstructures with advanced characterization techniques.

Dominique Bestion is Research Director at CEA. He has been working more than 20 years at the development and qualification of two-phase flow models for the CATHARE system code. He is now involved in the development of the NEPTUNE multi-scale thermal hydraulic platform as a coordinator of two-phase flow modelling activities. He is also coordinating thermal hydraulic activities of the NURESAFE European Project for a nuclear reactor multi-disciplinary and multi-scale software platform, and a Working Group of OECD-NEA for the application of CFD to nuclear safety.

Bernard Bonin is deputy scientific Director in the CEA's Nuclear Energy Division and Professor at INSTN. He has a background in fundamental research in high energy physics and materials physics. Between 1996 and 2000, he was Head of a Service for Research and Studies on Nuclear Waste, within CEA's Institute for Nuclear Protection and Safety. His studies then aimed at obtaining an overall view of the scientific basis for nuclear waste management. In 2000, he was appointed Assistant to the Director of R&D in COGEMA, in charge of the organisation of the R&D on the fuel cycle front-end, and on future nuclear energy systems.

Jean-Christophe Brachet is a CEA International Expert on nuclear materials and Professor at INSTN. His expertise covers physical metallurgy of chromium-rich ferritic-martensitic steels and zirconium alloys (in charge at CEA of the development and study of Cr coated Zr claddings for "Enhanced Accident Tolerant Fuel", behaviour in LOCA accidental conditions...). He authored more than 60 papers and participated to numerous international symposiums or workshops as lecturer or as chairman of specific sessions. He is inventor or co-inventor of 5 patents.

Cheikh M'Backe Diop is Research Director at CEA and Professor at INSTN, working at the Service of Reactor Studies and Applied Mathematics. He was Head of the Laboratory of Shielding Studies and Probability. He is co-author of a book on Radiation Protection and Nuclear Engineering. He teaches radiation shielding computational methods and the Monte Carlo method for simulating the particle transport in matter. He is the scientific manager of the Master Nuclear Reactor Physics and Engineering, which is run by the newly-created Paris-Saclay University.

Frederico Garrido is Professor of Materials Chemistry at the Université Paris-Sud, Orsay. He is an expert in the interaction of energetic particles with matter and radiation damage physics, especially applied to nuclear ceramic materials used as transmutation matrices (oxides and carbides). He has co-authored over 100 scientific papers in peer-reviewed journals. He became also a recipient of the Bronze Medal of the French National Centre for Scientific Research. In addition he is co-Director of the Master Nuclear Energy, which is run by the Paris-Saclay University.

Jean Noirot is International Expert at CEA. He has been working for more than 20 years in the field of nuclear fuel post-irradiation examination. With techniques going from gamma-scanning to micro-analyses, he has gained a wide experience on fuel behaviour, fast breeder reactor fuel, pressurized reactor fuel, including MOX, or dedicated experimentation on fuel in French or foreign test reactors. He has authored or co-authored more than 40 publications and book chapters.

Daniel Parrat is International Expert at CEA. He has been working for many years in the field of nuclear fuel behaviour, in particular on the release of fission products. He developed new methods and techniques for detection and characterization of failed LWR fuel rods in power plants for which he won a CEA prize. He has authored more than 40 papers in international conferences.

Christophe Poinssot is Head of the Radiochemistry & Processes Department of the Nuclear Energy Division, CEA Marcoule. He has been working for more than 15 years on different fields within the back-end of the fuel cycle, first on geological disposal, in particular the radionuclides migration and the long-term behaviour of non-reprocessed spent nuclear fuel, then on actinides recycling strategies regarding in particular their respective sustainability. He is Professor at INSTN, and invited Professor in actinides materials at the University of Sheffield. He has authored more than 100 papers and communications. He has been distinguished as Officer within the *Ordre des Palmes Académiques*.

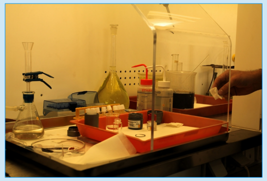
Alain Santamarina is Research Director at CEA. He is Professor of neutronics at INSTN. He was Head of EOLE and MINERVE reactor teams. When involved in fusion research, he coordinated the ITER neutronics/shielding and EFF nuclear data library. He is currently in charge of the validation of the French code package APOLLO2. Professor Santamarina is an Officer of the *Palmes Académiques*.

Jean-Marie Seiler is Research Director at CEA and Grenoble University. He has a deep expertise in the analysis and modelling of severe accidents for Light Water Reactors and Liquid Metal Fast Breeder Reactors. He has participated in many international working groups, experimental programmes and peer reviews.

Etienne Studer is Senior Expert at CEA in fluid mechanics and hydrogen risk issues. He has 20 years of experience working in the field of hydrogen risk in nuclear power plants. He is currently involved in experimental programmes (MISTRA facility) and modelling activities (CAST3M CFD code). He has participated to international experimental programmes, international working groups and state-of-the-art reports.

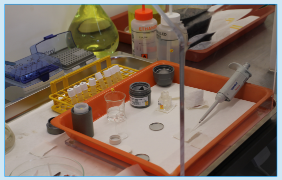
Target group

This dedicated training course aims at delivering the basics of nuclear and radiochemistry (NRC) to trainees with chemical background at Master level (chemistry masters or engineers, and/or fresh PhD students), who need to extend their skills and knowledge to the field of nuclear and radiochemistry.



Motivation

The lack of trained nuclear chemical specialists has been identified in all branches of nuclear industry and also in other areas where skills in NRC are required, such as radiopharmacy, nuclear medicine, radiation protection and radioecology, and many others. Retraining general chemistry graduates is one of the options for mitigating this problem.



Czech Technical University in Prague

Faculty of Nuclear Sciences and Physical Engineering

Department of Nuclear Chemistry

Břehová 7, 11519 Prague 1
Czech Republic

CINCH Consortium

Cooperation In education and training in Nuclear CHemistry

http://www.cinch-project.eu

CINCH-II is an EU 7TH Framework Programme project within EURATOM aiming to coordinate nuclear chemistry education and training in Europe.

The project initialized formation of the European Network on Nuclear Chemistry Education and Training and aiming to shift the education and training in nuclear chemistry to a quantitatively new level.

Contact:

malinakova@fjfi.cvut.cz

EUROPEAN COMMISSION
Community Research

CINCH

HANDS ON TRAINING IN NUCLEAR CHEMISTRY

Prague 2016
January 6-14

CINCH Consortium

SEVENTH FRAMEWORK PROGRAMME

Objectives

While the course does not substitute full formal training, it provides fundamental theoretical knowledge of principles and concepts in nuclear chemistry necessary for understanding the processes and methods in radiochemistry, and practical hands-on training required for the work with open ionising radiation sources (handling of radioactive materials, application of radionuclides and ionizing radiation, etc.).

Arrangements

The course is organised by CINCH Consortium and will take place at laboratories and lecture rooms of the Department of Nuclear Chemistry of CTU in Prague (Břehová 7, 11519 Prague, Czech Republic). In addition to attending lectures, the participants will pass thematic practical laboratory exercises.

All teaching will be in English.

Admission Requirements

For application for attendance of the course, please visit the CINCH web pages at www.cinch-project.eu/?art=courses, download the application form and send the filled-in form to Štěpánka Maliňáková (malinakova@fjfi.cvut.cz). No course fee will be charged to the participants and a small budget exists to support limited number of participants. Application deadline is November 30, 2015.

Accommodation

Accommodation in simple double rooms at CTU campus will be available for free.

Travel Information

http://www.idos.cz

http://www.dpp.cz/en/

http://www.prg.aero/en/

Introductory lectures (Jan 6-8, 2016)

Fundamentals of nuclear chemistry 1
Structure and properties of atomic nuclei.
Classification of radionuclides.
Kinetics of radioactive decay. Radioactive equilibria.
Binuclear reactions. Yield of nuclear reactions.

Fundamentals of nuclear chemistry 2
Natural radioactivity. Radioactive decay chains.
Nuclear fission, fission products. Hot atoms chemistry.
Szilard-Chalmers system. Radiation chemistry.
Actinides and transactinides.

Radiation detection and dosimetry
Interaction of IR with matter (α, β, γ, neutrons).
Detection of ionizing radiation (detector types, principles). Dosimetry of ionizing radiation.

Prerequisites

Radiation protection
Distance learning course on CINCH Moodle. Participants have to successfully finish this course before entering the on-site course.

http://cinch.moodlepartner.cz/

Practical exercises (Jan 11-14, 2016)

Handling of radioactive materials - pipetting, work behind shielding and in glove box.

Preparation of working solutions with required activity from the stock radionuclide.

Contamination survey, decontamination, preparation of wipe smear samples.

Radionuclide generator preparation and milking. Radioactive equilibria.

Sample activation via neutron irradiation.

Decay curve measurement and deconvolution, half-life determination.

Gamma-spectrometry – calibration, efficiency, measurement.

Liquid-liquid extraction of uranium. Uranium specific activity, estimation of its isotopic abundance.

Liquid scintillation counting.

www.cinch-project.eu

www.jaderna-chemie.cz

www.cvut.cz

INFORMATION

Programme managers

- Nihed Chaâbane, INSTN, CEA Saclay
  nihed.chaabane@cea.fr
- Rachid Belkhou, Synchrotron SOLEIL
  rachid.belkhou@synchrotron-soleil.fr

Language: English

Registration fee

Regular registration 1590 €
Students 795 €
Includes: lectures, documentation, shuttle service to Saclay, coffee-breaks and lunches

Registration deadline: October 20th, 2015

Contact & registration

Nadia Nowacki
Tel.: +33 1 69 08 30 92
Fax: +33 1 69 08 77 82
Email: nadia.nowacki@cea.fr

Further information (registration form, access map, hotels list...) is available on the web site: http://www-instn.cea.fr

Accommodation

Participants are invited to book their own accommodations. A list of hotels in Paris and in the vicinity of INSTN will be posted on the school web site.

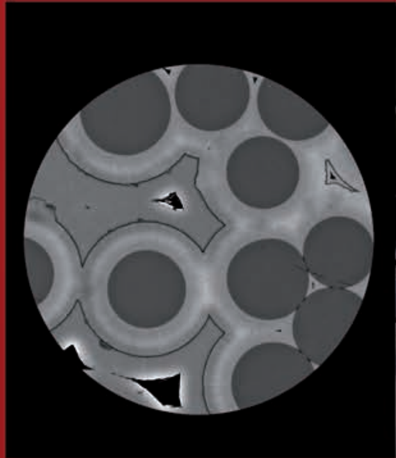
Location

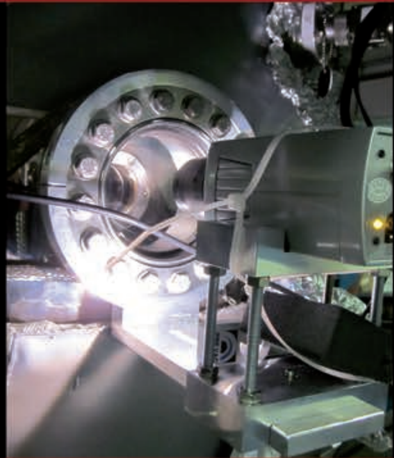
INSTN
CEA Saclay
91191 Gif-sur-Yvette, France

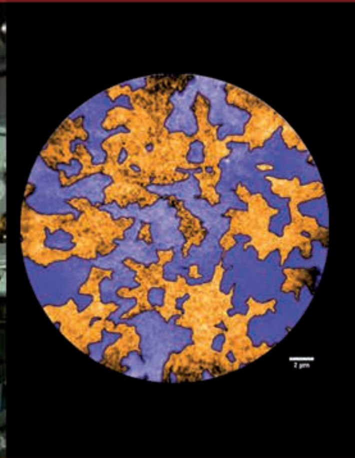
Synchrotron SOLEIL
Saint-Aubin
91192 Gif-sur-Yvette, France

INTERNATIONAL SCHOOL

PHYSICAL AND CHEMICAL CHARACTERIZATION OF SURFACES AT DIFFERENT SCALES


Composite SiC/SiC: SEM micrograph


Synchrotron SOLEIL: Beamline DEIMOS


Graphene on SiC/Si: LEEM micrograph

NOVEMBER 16th – 20th, 2015

SACLAY and SAINT-AUBIN, FRANCE

PART 1 LECTURES

PART 2 EXPERIMENTAL TRAINING

On-line application: http://www-instn.cea.fr

School aims and scope

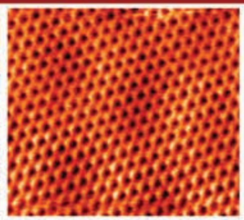
This international school aims at providing a thorough background in physical and chemical surface characterization, based on methods and instruments, to interested PhD students, Post-Docs and scientists working at European and non-European universities and laboratories. The school will cover the different aspects of surface analysis and appropriate analytical techniques in detail, from the most conventional (Raman spectroscopy, AFM/STM, IBA) to the most innovative requiring Synchrotron X-ray (X-ray spectroscopy, X-ray microscopy, X-ray diffraction/Scattering). The complementarity between laboratory and X-ray based techniques will be presented.

Plenary lectures and tutorials are given by specialists of materials science, solid state-physics, physico-chemical interface from CEA, Synchrotron SOLEIL and Paris Sud University. A substantial part of the programme is devoted to practical sessions carried out on cutting edge instruments, at the facilities of partner institutes and laboratories. In addition, a practical exercise on how to prepare a successful beam time proposal is given, as well as a poster session and a tour of SOLEIL. Examples presented during the lectures cover the variety of existing applications to physics and chemistry of condensed matter.

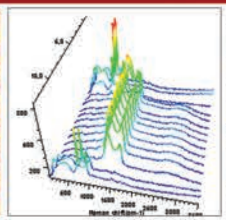
The attendees will be able to discuss their own projects with the speakers and other participants.

A poster session will be organized during the school. The attendees are strongly advised to submit a short abstract.

Synchrotron SOLEIL



Graphene/SiC STM image



SiC/SiC Raman spectra

HERMES beamline

Outline Programme

Introduction to surface analysis

- Notions of surface
- Photon-matter interaction
- ion-matter interaction

DIFFABS beamline

Laboratory conventional techniques

- Raman spectroscopy
- Scanning tunneling microscope
- Ion beam analysis (RBS, NRA)

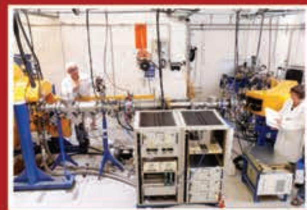
Raman spectroscopy instrument

Experimental training: conventional techniques

- Raman spectroscopy
- Scanning tunneling microscope
- Ion beam analysis (IBA)

Synchrotron based techniques

- X-ray microscopy
- Photoemission X
- Absorption X
- X-ray diffraction and scattering



Nuclear microprobe

Experimental training: Synchrotron X-ray techniques

- Photoemission (XPS, ARPES): SOLEIL beamlines (TEMPO).
- Absorption (XAS, SEXAFS, XMCD): SOLEIL beamlines (DEIMOS).
- Diffraction/Scattering: SOLEIL beamlines (DIFFABS, SIRIUS).
- X-ray microscopy: SOLEIL beamlines (HERMES, ANTARES).

INTERNATIONAL SCHOOL

PHYSICAL AND CHEMICAL CHARACTERIZATION OF SURFACES AT DIFFERENT SCALES

INSTN, Saclay, France

November 16-20, 2015

REGISTRATION FORM

SEXE: MALE ☐ FEMALE ☐

NAME: FIRST NAME:
NATIONALITY:
UNIVERSITY/COMPANY (NAME, ADDRESS, ADRESS OF INVOICE):

ADRESS OF INVOICE:

PHONE OFFICE, MOBILE, EMAIL:

TITLE/POSITION/JOB:
DATE OF BIRTH:
BIRTHPLACE (City/Country):
HOME ADDRESS:
PASSPORT NUMBER:
ISSUED AT:
DATE OF ISSUE:
DATE OF EXPIRATION:

I enclosed a proof of payment for registration fee:

FULL RATE €1590 ☐

STUDENT RATE €795 ☐

☐ **by cashier's check** to the order of CEA Saclay (*)

☐ **by bank transfer :**

Account holder	Commissariat Energie Atomique CEA (*)
Bank name	BNP
Bank branch address	1, Bd Haussmann – BP281 – 75425 Paris
Bank account number	30004 00818 00021216221 27
IBAN	FR76 3000 4008 1800 0212 1622 127
BIC	BNPAFRPPPVD

It is mandatory to mention on the bank transfer the name of the participant and the following mention: "Physical and chemical characterization of surfaces at different scales".

You will only be registered at the receipt of your payment.

e.mail: nadia.nowacki@cea.fr

LEAFLET

NUCLEAR FUEL CYCLE

September 28 to October 9, 2015

INSTN - CEA/SACLAY
FRANCE

Ref. 087

Duration

10 days - 66 hours

Programme manager

Lionel BION

Public

Technicians, scientists and engineers working in nuclear sciences and industry and wishing to have advanced knowledge in the field of nuclear fuel cycle.

Venue

The conferences will be given at the National Institute for Nuclear Sciences and Technology (INSTN), as member of European Nuclear Education Network (ENEN Association), located at the CEA Saclay facilities (20 km southwest of Paris) and possibly, depending on the final organization of the technical visits, in another location.

Objectives

From the extraction of the uranium ore to the reprocessing of spent fuel, as well as on the management of waste produced during the different stages of the fuel cycle, the trainees will be able to integrate and restitute at different degrees of implementation comprehensive information and in-depth knowledge on the industrial operations related to the nuclear fuel cycle in France.

Course content

- The nuclear fuel cycle: an overview
- Geology of uranium: exploration, mining and resources
- From uranium ore to yellow cake: the concentration stage
- From uranium ore concentrates to uranium hexafluoride UF_6
- Uranium enrichment: overview
- Boiler/Fuel: the constraints
- Fuel assembly: general design
- Recycling industry: Mixed oxide fuel (Mox)
- Fuel rod and assembly: thermal-mechanical design
- Fuel services
- Uranium enrichment by gaseous diffusion and ultracentrifugation processes
- Options for spent fuel management
- French experience with interim storage technologies
- Transport of nuclear fuel cycle materials
- Fuel cycle front-end: technical and economical aspects
- Reprocessed uranium recycling
- Reprocessing operations and technology
- Inventory of fuel cycle wastes and long term waste management
- R&D in the field of the long-lived nuclear waste management: advanced separation, transmutation and long-term interim storage

LEAFLET

NUCLEAR FUEL CYCLE

September 28 to October 9, 2015

INSTN - CEA/SACLAY
FRANCE

Ref. 087

Methods

Conferences and technical visits *(subject to acceptance)*:

- Uranium fuel fabrication plant (FBFC - AREVA)
- Uranium refining and conversion plant (COMURHEX - AREVA)
- Uranium enrichment plant (EURODIF - AREVA)
- Mox fuel fabrication plant (MELOX - AREVA)
- Na-FNR (Phenix- CEA/EDF)
- La Hague spent fuel reprocessing plant (AREVA NC)
- Storage site for low radioactivity waste (ANDRA).

Maximum number of trainees: 18

This course includes visits of facilities with regulated zones. Please comply with the conditions stated in the terms of sale.

Deadline of registration

August 21st, 2015

Registration fee

7 610 € (including Parisian accommodation)

5 530 € (without Parisian accommodation)

6 370 € (ENEN members)

4 845 € (students)

The fee includes lectures, documentation, workshop papers, lunches, most dinners, hotel accommodation (three-star hotels) and transportation (high speed TGV trains, first class) during the seminar and the technical visits. The fee does not cover travel expenses to France.

Contact

Programme manager: Lionel BION
lionel.bion@cea.fr – Phone: +33 1 69 08 26 96

Organizer: Corinne CARREAUX
corinne.carreaux@cea.fr – Phone : +33 1 69 08 25

Please visit our web site : www-instn.cea.fr

REGISTRATION FORM

Please duly fill out this form by computer and send it back to us **no later than** ***August 21st, 2015*** by email to : corinne.carreaux@cea.fr

➪ *Your identity* :

Family name : First name : Gender : ☐ F ☐ M

Date of birth (Day/Month/Year) : Nationality :

Institution/Company :

Address of **invoice** (*) :

City Code : City : Country :

Phone : + Fax : + E-mail :

Position : PhD student ☐ post-doc ☐ researcher ☐

engineer ☐ other ☐ please specify :

Specific diet : Food allergies :

(*) ***If your Account Department requests a special mention on the invoice, please be so kind as to indicate it here :***

➪ *Registration fee* :

Fee covers lectures, documentation, lunches as well as accommodation, transportations and meal during the technical visits. The fee does not cover travel expenses to France.

☐ 7 610 € including Parisian accommodation

☐ 6 374 € ENEN members including Parisian accommodation

☐ 5 530 € without Parisian accommodation

☐ 4 845 € Student including Parisian accommodation
Certificate of attendance at school or university (e.g. a copy of the student card) is needed and should be addressed with this form.

The number of participants is limited to 18.

…/…

⇨ ***Registration fees can be paid*** :

☐ **by purchase order**

☐ **by cashier's check** to the order of CEA Saclay

☐ **by bank transfer <u>for the full amount</u> (any bank charges are payable by the participant) :**

Account holder	Commissariat Energie Atomique CEA
Bank name	BNP
Bank branch address	Paris Place Vendome (00818)
Bank account number	30004 00818 00021216221 27
IBAN	FR76 3000 4008 1800 0212 1622 127
BIC	BNPAFRPPPVD

The bank transfer must clearly state the name of the participant as well as the following mention : <u>"INSTN/NFC 2015"</u>. In case of payment made for more than one participant, please make sure that each name is properly indicated.

<u>Deadline of payment</u> : **September 7, 2015**

You will be registered only on <u>receipt of payment</u>. The bank transfer or at least proof of payment (i.e. a copy of the bank transfer order) should be sent by this deadline.

<u>Terms of sale</u> :

Any course that is begun will be invoiced in full. In case of non-presence during the training course, please note that there will have no refund of the registration fees, except for an absence due to a **medical problem** that can be duly supported by certificate – a copy of the medical leave form will be requested. Please also notice that in case of withdrawal, the cancellation must be confirmed **in writing at least 14 calendar days** <u>before the start of the training course</u> ; otherwise 70 % of the registration fees will be due as forfeit.

Invoices are issued **at the end** of the training course and will be sent by mail to the **invoice address written on this registration form**. No invoice will be reissued.

⇨ ***We would like to know more about your interest in nuclear fuel cycle. Therefore we invite you to answer the following questions*** :

Education and background :

Research interest :

Industrial processes :

What do you expect from this course ?

GENTLE
Graduate and Executive Nuclear Training and Lifelong Education

Professional Education on Nuclear Energy

In the ever-changing European and global energy sectors, one thing remains constant: the interest in nuclear power. This interest can be found not only in numerous developed countries, among which several EU Member States, but also in an increasing number of emerging/developing economies which have started to take the potential of nuclear power seriously into account. As a result, the demand for highly educated nuclear engineers and scientists in industry, research, technical safety and governmental organisations is increasing. A highly skilled and up-to-date workforce plays a crucial role in responsibly maintaining the civil nuclear reactor fleet and decommissioning obsolete plants. In addition to this, it is imperative to involve a well-educated workforce in designing and building new nuclear infrastructure and in dealing with radioactive wastes.

Professional Education on Nuclear Energy

Therefore high quality education and training for workforce is essential for the future of the nuclear power sector. In an effort to stimulate and coordinate training in this field, the European Commission has recently brought together 11 leading academic and research institutions in Europe and a range of other stakeholders to create a sustainable lifelong training programme in the field of nuclear fission technology. This co-called GENTLE network offers professionals the opportunity to enrol in the Professional Education on Nuclear Energy, a unique programme designed by Europe's leading experts to meet the needs of nuclear industries, research and technical safety organisations.

An educated, well-trained workforce is essential for the future of the nuclear power sector.

Expertise

The GENTLE network that coordinates the course consist of Delft University of Technology (The Netherlands), Budapest University of Technology (Hungary), the CIRTEN interuniversity consortium for technological nuclear research (Italy), Karlsruhe Institute of Technology (Germany), Technical University of Madrid (Spain), The Belgian Nuclear Research Centre SCK•CEN (Belgium), The University of Manchester (UK), Paul Scherrer Institute (Switzerland), University of Tartu (Estonia), Lappeenranta University of Technology (Finland) and the Joint Research Centre of the European Commission. Learn more about the GENLTE network on gentleproject.eu.

Benefits

- Several large nuclear organisations support the course; participants have the opportunity to create links with the top employers in the nuclear industry.
- Eleven leading European institutes contribute to the curriculum, all supplying their unique specialism.
- The scope of the programme is truly international, with contact days in several countries.
- This modular programme covers all base theoretical and practical aspects regarding nuclear energy. Each module can be attended separately as its content covers the full scope of the module topic.
- The programme offers a hands-on approach, which includes extensive practical training.

Programme

Attending the full programme takes a little bit over one year and consists of five modular parts. All modules can also be followed sepertaly, if this suits your needs better. The first four modules aim to provide the participants with the suitable background and the specific knowledge about Nuclear Energy Systems and their main features through lectures, instructions and site visits. The fifth module is devoted to provide soft skills that are critical in the nuclear sector.

Topics

Module 1 – Understanding nuclear power - Delft University of Technology - June 2015

- Societal, economical and technical perspectives on nuclear energy
- Fundamentals of nuclear science, nuclear chemistry, thermal hydraulics, radiation protection and nuclear reactor physics
- Nuclear fuel cycle and waste management

Module 2 – Producing energy with nuclear reactors - Karlsruhe Institute of Technology - October 2015

- Principles of energy generation with nuclear reactors
- LWR systems for energy generation and conversion including safety systems (PWR, VVER and BWR)
- Operational aspects of PWR
- Fundamentals of neutron physical and thermal hydraulic core design (principles, current methods, trends)
- Dynamic behaviour of LWRs
- One-day visit of the training reactor of IKE Stuttgart University (experiments, measurements)

Module 3 – Nuclear fuel from ore to waste - Joint Research Centre - Karlsruhe - February 2016

- Fundamentals of actinides chemistry and physics
- Where nuclear fuel comes from?
- How does it behave in the reactor?
- What to do with used fuel nuclear fuel afterwards?
- Existing technologies and future developments

Module 4 – Societal justification, safety and security of nuclear energy - SCK•CEN - Mol - April 2016

- Science, politics and ethics of nuclear technology assessment
- Nuclear safeguards and security aspects
- Nuclear safety aspects (deterministic and probabilistic approaches)
- Nuclear safety culture and methodologies for safety assessment
- Decommissioning of nuclear plants issues

Module 5 – Management systems - CIRTEN - Milan - June 2016

- Quality management principles
- Project management issues
- General soft skills
- Insights into the interaction processes with Safety Authorities and Regulatory Bodies

For more information about the specific dates of the modules we refer to the nuclear energy website.

Target group

The Professional Education on Nuclear Energy course is designed for professionals positioned in industry, consultancy companies, research organisations, (inter) governmental organisations and regulatory bodies. The programme is especially attractive for professionals (e.g. more than 3 years working experience) who have an MSc level degree in a technological/scientific area but who do not have a nuclear engineering background. The programme is open to qualified candidates from all over the world.

Study load

Every module has a workload of 8 ECTS credits. The modules have 80 face-to-face lecture hours combined with 140 hours for preparation, distant learning and homework assignments.

The total programme duration is little bit more than one year and upon successful completion of every individual module, you will receive a certification.

Tuition fee

In 2015 the programme will be offered for the introductory price of € 18,000.00 per participant for the complete programme. Individual modules can be attended individually for a price of € 3,600.00 per module.

These tuition fees cover all necessary costs; the complete study programme, books, access to student facilities, excursions, hotel and all the meals for the programme duration. (Travel arrangements to and from the lecture locations are not included).

You will visit 5 nuclear institutes

The Professional Education on Nuclear Energy offers you inside knowledge from 11 leading nuclear research institutes in Europe. You will have the extraordinary opportunity to visit 5 nuclear centres of expertise and learn firsthand about nuclear energy systems. The remaining partners will join you in these 5 locations to give you the best nuclear education possible.

Module 1 takes place at the Reactor Institute Delft (RID) at Delft University of Technology. Here you will visit a pool-type nuclear reactor, built specifically as a source of neutrons and positrons for fundamental and applied scientific research into areas such as health and sustainable energy. During Module 2, held at the Institute for Nuclear Waste Disposal (INE) of the Karlsruhe Institute of Technology, you will experience facilities to study the geochemical aspects of the long-term safety of nuclear waste disposal, equipped for working with radionuclides of all types including reactor fuels and alpha emitters. Module 3 is led by the JRC Institute for Transuranium Elements (ITU) in Karlsruhe, which is an inspiring location as its laboratories are equipped to deal with all stages of the fuel cycle. Module 4 is held at the Belgian Nuclear Research Centre (SCK•CEN), home to three operational research reactors, one in the process of being decommissioned and an underground laboratory dedicated to the study of potential geological host formations for long-lived and highly active nuclear waste. Finally, Module 5 takes place in Milan at CIRTEN, the joint centre of nuclear expertise of 6 universities in Italy, where you will learn everything about nuclear management systems.

Stakeholders

The stakeholders are in dialogue with the partners to difine the programme content. The stakeholders involved are AREVA (France), CNU (Romania), Eesti Energia (Estonia), ENEN (France), ENS (Belgium), FORATOM (France), NNL (UK), NRG (Netherlands), NUGENIA, SNETP (France), TVO (Finland), Urenco (Netherlands), Westinghouse (Sweden).

Partners

The following partners contribute to the Professional Education on Nuclear Energy programme.

Contact

Rene Tamboer
+31 15 278 3892
info@nuclearenergy.education
www.nuclearenergy.education

21 - 04 - 2015

MODULE 2: Producing Energy with Nuclear Reactor Topics

Main coordinator: Karlsruhe Institute of Technology
Teaching unit: Institute for Neutron Physics and Reactor Technology
Dates: the 28th of September to the 9th of October 2015
ECTS credits: 8
Teaching language: English

Teaching staff:

Module manager: Victor Hugo Sanchez-Espinoza
Other teachers: Antonio Cammi, Wadim Jeager, Boris ??, Légrády Dávid, Javier Jimenez, Carolina Ahnert, Riitta Kyrki Rajamki, Juhani Hyvarinen, Joerg Starflinger

Main topics: Energy production with nuclear reactors; Mechanisms of heat removal from the core under nominal operation conditions (PWR, BWR); Regulatory framework for the design of nuclear power plants (safety requirements, criteria, etc.); Fundamentals of nuclear design (neutronic, thermal hydraulic); Nuclear power plant main systems; Operational aspects of nuclear power plants; Trends in nuclear power plant design and construction.

Table 1: Course overview of Module 2 “Producing Energy with Nuclear Reactor Topics”

	MODULE 2: Producing Energy with Nuclear Reactor Topics	Hour	GENTLE Partner	Teachers
1	Introduction to energy generation by fission	1	KIT	
2	PWR systems:	7	KIT	
3	BWR systems:	7	CIRTEN	
4	VVER Reactors	7	BME	
5	Neutronic core design:	8	KIT	
6	Thermal Hydraulic core design:	8	KIT	
7	Operational aspects of PWR	8	UPM	
8	Dynamic Behaviour of LWRs:	8	LUT	
9	Visit to Research and Training Reactor at tgart	8	IKE	
1	Exercises including demos of simulations	20	all	

Teaching Methods *(same for every module):*
The lectures are built up from 4 parts. Every lecture hour asks 2-hour preparation, homework and examination of the student. 30minute preparation, 50minute lecture hours, 60minute study and 30minute assignment time.

MD.1. **Distant learning**. Prepare the subjects you are going to study at the course by watching online-lectures of your lectures at the location or reading some parts of the study literature (30 minutes per lecture hour).
Teachers need to prepare preparation work, online-lectures or pre-reading assignments. For examples of online-lectures see the You-Tube channel of Jan-Leen Kloosterman:
https://www.youtube.com/channel/UCi-0od2nkp7fUWZIUwTuO6Q
MD.2. **Lectures**. Learning in presentations by the Professors of Nuclear Energy about different topics, processes, methods, etc. The exposition is logically structured with the aim of providing a theory concepts, show the way to solve the different types of problems, point out the stages of the processes and standard procedures, indicate the correct way of using tools and calculations.
MD.2.1 **On-site visits**. Gain deeper and broader insight into the operation principles and other non-technical aspects (economical, environmental, societal, etc). See in real-life the things you are educated in the lectures.
MD.3. **Exam**. At the end of each programme week multiple-choice questionnaire will be filled out to test the knowledge received that week.
Teachers need to prepare one or two multiple-choice questions per lecture hour.
MD.4. **Homework assignment**. Given study material studied at home with an assignment that will be handed in through mail or e-mail with the module coordinator (per lecture hour: 60 minutes homework, 30 minutes assignment).
Teachers need to prepare assignments of 30 minutes per lecture hour.

Study book list:

Nuclear power plants (BWR, PWR, VVER)

- Handbook on nuclear engineering, Cacuci or DOE books

Thermal hydraulic and neutronic core design, operational aspects and regulation:

- R.T. Lahey, Jr., F. J. Moody, “Thermal –hydraulics of Boiling water reactor”, Second Edition, ANS, 1993.
- N.E. Todreas, M. Kazimi, “Nuclear Systems - Volume I: Thermal Hydraulic Fundamentals”, “Nuclear Systems - Volume II: Elements of Thermal Hydraulic Design”, CRC Press, Second Edition, 2011.
- J.J. Duderstadt, L. Hamilton, “Nuclear Reactor Analysis”, John Wiley & Sons, 1976.

New trends in core design

- T. Saito, J. Yamashita, Y. Ishiwatari, Y. Oka, “Advances in Light Water Rector Technology”, Springer, 2011.
- D. Cacuci, “Handbook of nuclear Engineering. Vol.2 Reactor Design. Vol3: Reactor analysis, Vol.4: Reactors of Generation III and IV”, Springer, 2010.

Table 2: Lecture overview of Module 2 “Producing Energy with Nuclear Reactor Topics”

	MODULE 2: **Producing Energy with Nuclear Reactor Topics**	**Book**	**Hour**	**GENTLE Partner**
1	**Introduction to energy generation by fission**		**1**	**KIT**
2	**PWR systems:**		**7**	**KIT**
	Nuclear power plants with PWR of Generation II and III		2	
	Mains systems and heat transfer mechanisms of PWR of Gen-II and –III		2	
	Safety systems, decay heat removal systems of PWR of Gen-II and III		2	
	Discussion		1	
3	**BWR systems:**		**7**	**CIRTEN**
	Nuclear power plants with BWR of Generation II and III		2	
	Mains systems and heat transfer mechanisms of BWR of Gen-II and –III		2	
	Safety systems, decay heat removal systems of BWR of Gen-II and III		2	
	Discussion		1	
4	**VVER Reactors**		**7**	**BME**
	Overview of different VVER reactor types		2	
	VVER main systems		2	
	Special features of VVER reactors		2	
	Discussion		1	
5	**Neutronic core design:**		**8**	**KIT**
	Neutronic core design principles and criteria		2	
	Numerical codes for core design (main physical models, validation, application)		2	
	New trends in neutronic core design		2	
	Neutronic characterization of reactor cores at nominal operation conditions		2	
6	**Thermal Hydraulic core design:**		**8**	**KIT**
	Thermal hydraulic core design principles and design criteria		2	
	Numerical tools for thermal hydraulic core design (main physical phenomena, validation, application)		2	
	Trends in thermal hydraulic core design		2	
	Thermal hydraulic characterization of reactor cores at nominal operation conditions		2	
7	**Operational aspects of PWR**		**8**	**UPM**
	Temperature effects on reactivity		2	
	Effects of Xe and Sm		2	
	Technical safety limits		2	
	Optimal control modes and manoeuvres		2	
8	**Dynamic Behaviour of LWRs:**		**8**	**LUT**
	Basic reactor kinetics equations		2	
	Inhour equation and prompt jump		2	
	Fast power excursions		2	
	BWR control and stability		2	
9	**Visit to Research and Training Reactor at IKE Stuttgart**		**8**	**IKE**
	Basic neutronic experiments (e.g. neutron activation experiments, measurement of the radial flux profile, calibration of the absorber plates, radiation measurement, a- and g-spectrometry)		8	
1	**Exercises including demos of simulations**		**20**	**all**
	TOTAL		**82**	

Table 3: Core learning outcomes in Module 2 "Producing Energy with Nuclear Reactor Topics"

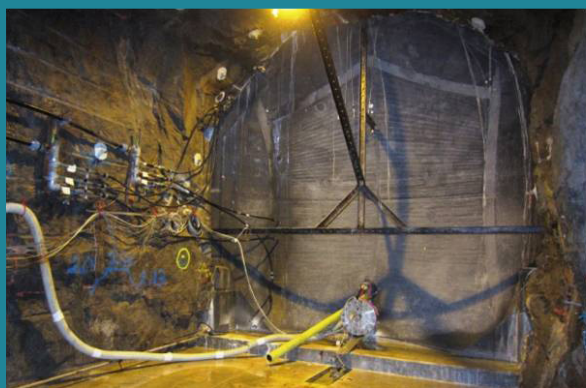
	Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
MODULE 2: Producing Energy with Nuclear Reactors	K1. Know how main nuclear power plant types are constructed and design. K2. Know the main safety and decay heat removal systems of NPP. K3. Understand the most important heat transfer mechanism in nuclear reactors. K4. Describe main operational parameters of PWR, BWR and VVER. K5. Describe the reactor core of PWR, BWR and VVER. K6. Expain the main Emergency Core Cooling Systems of PWR, BWR and VVER. K7. Understand the main models of thermal hydraulic and neutronic design tools. K8. Understand reactivity insertion and feedback on neurtronics. K9. Follow and understand the operational aspects and reactor dynamic NPP behaviour. K10. Analysis of the Xenon and Samarium evolution and influence in the axial power distribution. K11. Technical specifications for the safe operation of the NPP. K12. Critical control operation of the NPP. K13. Evolution of the axial power distribution in the operational manoeuvres. K14. Concept of axial offset.	S1. Ability to judge the status of a nuclear power plant. S2. Ability to apply numerical tools for thermal hydraulic and neutronic core design. S3. Assess the safety status of nuclear reactors. S4. Understand measurement principles of radiation, flux profiles, etc. S5. Assess the safety status of nuclear reactors. S6. Prediction of the optimal and safe operation of the NPP. S7. Analyse the optimal control mode for standard manoeuvres. S8. Compare the safety performance of operating VVER reactors with respect to BWR and PWR. S9. Compare the operational and safety performance of Gen III VVER to other Gen III reactor types. S10. Compare the advantages and disadvantages of horizontal steam generators to vertical PWR steam generators. S11. Explain the main differences between Generation II and III reactors (VVER, PWR, BWR). S12. Compare the severe accident management systems of Gen III VVER reactors to other Gen III PWR reactors.	C1. Be able to safe operation and design of nuclear power plants. C2. Judge the operational status of nuclear power plants and their safety parameters. C3. Apply design principles and criteria to optimize the core design and safety features. C4. Analysis of reactor dyanmics including neutronic feedbacks for safe reactor operation. C5. Assess radiation fields depending on type of radiation. C6. Contribute to safe operation and design of nuclear power plants. C7. Judge the operational status of nuclear power plants and their safety parameters. C8. Compare the optimal control mode with the real operational to improve the safe operation.

DOPAS

Training Workshop 2015

14 - 18 September 2015

Czech Republic, Prague and Josef URC



5-Day Training Workshop
on the Role of Full-scale Experiments on Plugs and Seals
in Demonstrating Safety and Performance
of Geological Disposal

Registration Deadline 10 August 2015

More info:
www.posiva.fi/en/dopas

igd·tp
safe solutions for radioactive waste

EURATOM

DOPAS

Learning Outcomes

The 5-Day DOPAS Training Workshop is targeted to full-scale experiments on plugs and seals in geological disposal of radioactive wastes. The workshop learning activities are designed to enable the workshop participants to acquire a set of learning outcomes based on the experiences of the DOPAS project and demonstration programmes of nuclear waste management organisations.

The expected learning outcomes for the participants are:

- To understand the process/es of designing a full-scale experiment from a set of requirements related to the performance of the safety function/s of a plug or a seal as a repository component in geological disposal.
- To be able to contrast the differences of such processes resulting from the different boundary conditions e.g. from the host rock environments (clay, crystalline rock, and salt), the experimental settings (above ground, underground experimental facilities vs. real repository conditions) and other site and disposal concept specific features.
- To comprehend the linking of different experiment project's related subprojects and tasks and their inputs and outputs as a part of the experiment implementation.
- To acquire hands-on experiences in experimenting with materials' testing and monitoring techniques needed in an experiment, and
- To know how the individual experiments and their outputs contribute to the overall demonstration and demonstration programmes for safety of the waste management programmes at the different stages of repository development.

This training workshop is a part of the Euratom FP7 DOPAS project. It is designed and implemented in collaboration by Posiva Oy, Czech Technical University (CTU), Andra, SKB, SURAO, RWM, Nagra, GRS, and UJV (REZ). The learning units of this training workshop are also based on the experiences gained from the DOPAS project experiments FSS in France, EPSP in the Czech Republic, DOMPLU in Sweden, POPLU in Finland, and ELSA planning in Germany.

Registration to the DOPAS Training Workshop

The last registration/application date to the DOPAS training workshop is **August 10, 2015**. Please send your applications including the information below by August 10, 2015 to the following e-mail address: dopas@posiva.fi
The registration form is also available on the DOPAS website: www.posiva.fi/en/dopas .

Registration information required:

Full name:____
Organisation: ______________________________________
Street address:______________________________________
Postal code/Town/Country: ______________________________
E-mail: ____
Telephone (incl. country code): ____________________________
Other information:____________________________________
Your role: professional or student
As a professional or student, describe the relation of the training workshop to your work or studies:
____
____
Dietary restrictions:___________________________________
Free field for comments:________________________________
____
____

Schedule, Related Learning Units and Locations

The DOPAS Training Workshop starts on Monday 14 September 2015 at 9 hrs a.m. at the Czech Technical University (CTU) in Prague and continues until 4 p.m. on Friday 18 September 2015. The workshop comprises also practical exercises at the Regional Underground Research Centre Josef (Josef URC) of CTU, 60km south of Prague. The length of the individual days varies due to the logistics and other activities. In general, with the exception of the first and last day, the training days extend from around 7:45 am to around 9 p.m. in the evening.

DAY 1

14.9.2015 at CTU in Prague

- Orientation to the DOPAS Training Workshop.
- Learning Unit 1: From requirements to the design basis of plugs and seals including the understanding of requirements management systems and their applications to plugs and seals and developing a basis and scoping an experiment from a project management perspective.

DAY 2

15.9.2015 at Josef URC

- Orientation to the Josef URC and Josef Underground Laboratory
- Learning Unit 2: Preparation of a full-scale plug or sealing experiment in different environmental settings including the development of a coherent demonstrator programme for plugs and seals and the role of intrumentation and monitoring in such an experiment with a hands-on exercise in Josef Underground Laboratory (also in Learning Unit 3).

DAY 3

16.9.2015 at UJV Research Centre in REZ close to Prague and at SURAO in Prague

- Learning Unit 2 continues with what is expected to follow in a demonstrator programme resulting from the implementation of such experiments.
- Learning Unit 3: Designing a sealing component for an experiment or demonstrator and the role of safety assessment and performance assessment of closure as a design input. This unit is about how to move from the initial design in an iterative manner to the final experiment design and construction, and how to assess the outcomes. It also addresses the behaviour of plug component materials and provides practical materials' related testing exercises in a laboratory setting.
- Introducing SURAO's programme on siting and deep geological repository, and information activities to the general public.

DAY 4

17.9.2015 at Josef URC

- Learning Unit 3 continues with an introduction to safety assessment and the role of safety case taking into consideration the differences in the time perspectives. The afternoon of DAY 4 includes the handling and interpretation process of data acquired from the Josef Underground Laboratory hands-on monitoring exercise.
- Learning Unit 4: Construction feasibility of a plugging experiment includes the practical and technical concerns related to the construction work and work methods in setting up an in-situ or full-scale experiment. Experiment and work related risks are identified and discussed as a part of this learning unit. This learning unit continues on DAY 5.

DAY 5

18.9.2015 at CTU, Prague

- Learning Unit 4 continues with the summary perspectives on lessons learned from the experiments until today, and how to apply and use the DOPAS experiences in a waste management programme not yet in the demonstration stage or without a site. Further a case summary is provided in how these activities are implemented in the preparation of a full-scale experiment to be implemented following the four existing DOPAS experiments.
- Student groups provide their preliminary or final exercises reports and preliminary assessment and feedback from the training workshop is collected. Closing of the workshop.

Please note that changes to the order of the content and individual programme details may apply.

DOPAS
Training Workshop 2015
14 - 18 September 2015

Practicalities on Course Fees and Accommodation

The DOPAS Training Workshop participation is free of charge to the selected participants including local transportation (Monday-Friday) from designated hotels to the training locations, daily lunches, and coffees during the workshop.

The participants are responsible for their own travel to and from and for accommodation expenses in the Czech Republic. Block booking for accommodation is made in Prague and information about it will be sent to the registered participants after the registration is received.

For conditional accommodation support of full-time university students, please make sure that you mention in your application that you are a full-time university student and give the name of your university and professor. This support is discretionary and will not be guaranteed to any participant.

The total number of participants is limited to 12 students. Priority is given to participants coming from other than the DOPAS project consortium organisations. The detailed selection criteria in case of oversubscription to the workshop will be posted on the DOPAS website at http://www.posiva.fi/en/dopas

Special Requirements for the Participants

The training workshop participants need to fulfil the following requirements:
- Each individual needs to be able to move unassisted and carry out hands-on exercises underground.
- Each individual needs to have insurance coverage against injuries and illness for the duration of their stay at the workshop. Please check the sufficiency of your insurance coverage prior participation. Proof of sufficient insurance coverage may be requested by the organisers.
- To inform the organisers at the time of registration of any dietary restrictions that may apply.

For More Information

For more information about the DOPAS training workshop and its details visit www.posiva.fi/en/dopas or contact Mrs Marjatta Palmu at Posiva Oy marjatta.palmu(at)posiva.fi.

The research leading to these results has received funding from the European Union's European Atomic Energy Community's (Euratom) Seventh Framework Programme FP7/2007-2013, under Grant Agreement No. 323273 for the DOPAS project.

REMEMBER ALSO

DOPAS 2016 Seminar

International Topical Seminar On Plugging And Sealing

25 - 27 May 2016, Turku, Finland

www.posiva.fi/en/dopas

FREDERIC JOLIOT / OTTO HAHN
SUMMER SCHOOL ON NUCLEAR REACTORS
Physics, Fuels, and Systems

energie atomique – energies alternatives

Karlsruhe Institute of Technology

FIRST ANNOUNCEMENT

Karlsruhe Castle

Akademiehotel Karlsruhe

Karlsruhe Pyramide

The 2013 Frédéric Joliot/Otto Hahn Summer School will be held at the Karlsruhe Institute of Technology, Germany, from August 21 to August 30, 2013, on:

Advanced Nuclear Systems with Transuranium Fuels

Topic 1:	**Introduction**	**6 h**
Topic 2:	**Fast critical reactors and transmutation**	**6 h**
Topic 3:	**Transmutation in sub-critical accelerator-driven systems**	**9 h**
Topic 4:	**Partitioning and separation processes**	**4 h**
Topic 5:	**Advanced fuels**	**9 h**
Topic 6:	**Ultimate waste management**	**4 h**
Seminar:	**Societal economic frame for an implementation of nuclear systems**	**2 h**

Technical visits

The lectures will be given by a large panel of distinguished speakers from R&D organizations, universities, industry and international institutions.
In addition, special events and a weekend programme will be organized.

For information on the detailed program, registration procedure, fees, etc. please contact:

Mrs. Ingeborg Schwartz, Karlsruhe Institute of Technology, INR
76344 EGGENSTEIN-LEOPOLDSHAFEN, GERMANY
Phone: +49 (0) 721 6082 2552 Fax: +49 (0) 721 6082 3718 E-mail: ingeborg.schwartz@kit.edu
http://www.fjohss.eu

Full Registration Fee EUR 1.800 (travel expenses not included) -
Reduced Fee EUR 900 for fellowship recipients

The Frédéric Joliot/Otto Hahn Summer School is jointly organized by the Nuclear Energy Division of the *Commissariat à l'Energie Atomique* (CEA/DEN), France, and the *Karlsruhe Institute of Technology* (KIT/INR), Germany

FJOH 2013

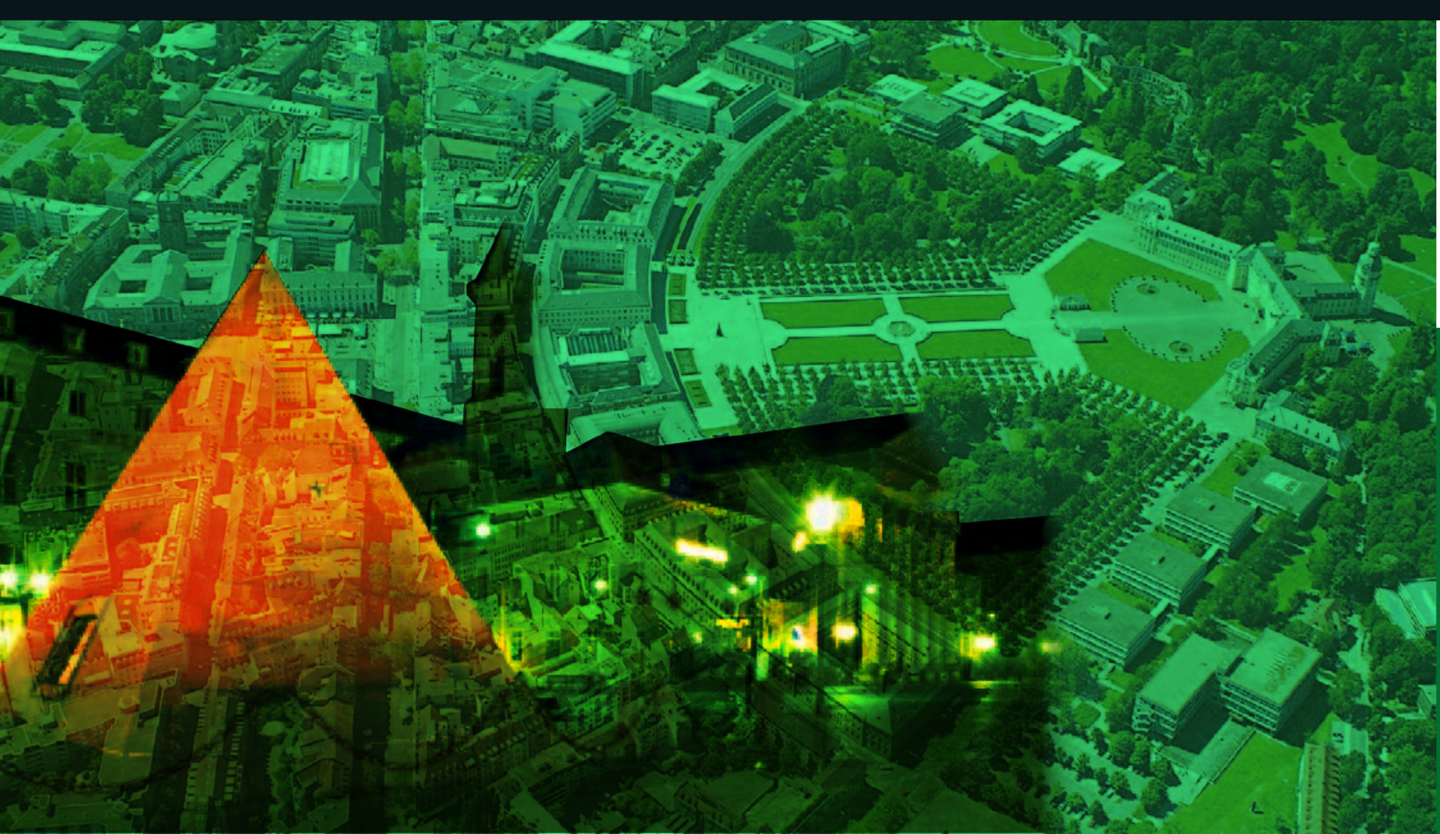
Frédéric JOLIOT & Otto HAHN
SUMMER SCHOOL
ON NUCLEAR REACTORS
"Physics, fuels and systems"

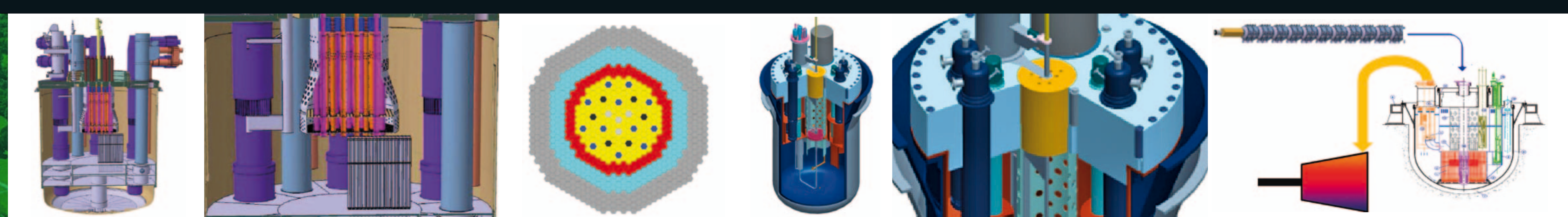
ADVANCED NUCLEAR SYSTEMS WITH TRANSURANIUM FUELS

Application deadline
May 17, 2013

Karlsruhe Germany

August 20 > 30, 2013





PROGRAMME OUTLINE

- Introduction and Overview
- Fast Critical Reactors and Transmutation
- Transmutation in Sub-critical Accelerator-driven Systems
- Partitioning and Separation Processes
- Advanced Fuels
- Ultimate Waste Management
- Seminar
  Societal and Economics Conditions for the Development of Nuclear Systems
- Technical visits of Karlsruhe Institute of Technology R&D facilities

LECTURERS

Jean-Marc Cavedon (PSI)
Dominique Warin (CEA)
Kazuo Minato (JAEA)
Bruno Fontaine (CEA)
Konstantin Mikityuk (PSI)
Bernard Carluec (AREVA)
Concetta Fazio (KIT)
Holger J. Podlech (Frankfurt University)
Annick Billebaud (CNRS/LPSC)
Hamid Aït Abderrahim (SCK-CEN)
Robin Taylor (NNL)
Hansoo Lee (KAERI)
Joseph Somers (EC/JRC-ITU)
Nathalie Chauvin (CEA)
Rory Kennedy (INL)
Klaus-Jürgen Brammer (GNS)
Claes Thegerström (SKB)
Harri Tuomisto (Fortum)

Extra-curricular and social events and an attractive weekend programme will be organized.

- Full registration fees: 1800 euros.
  Reduced fees: 900 euros for fellowship recipients.

Karlsruhe Institute of Technology

DE LA RECHERCHE À L'INDUSTRIE
cea
CADARACHE

School Directors
- Prof. R. Stieglitz (KIT)
- Dr. R. Jacqmin (CEA)

For information, please contact the FJOH school secretariat at:
ingeborg.schwartz@kit.edu

Application

All FJOH-2013 school applicants should fill out the on-line form at:

www.fjohss.eu

Should there be any problem with the on-line registration, please contact:

Mrs. Ingeborg Schwartz
Karlsruhe Institute of Technology, INR
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Deadline for application: May 17, 2013

Full registration fees: € 1800

Reduced Fees: € 900 for fellowship recipients

Information for payment of the fees will be provided upon review of applications.

The fees cover: lectures, class notes, excursions, meals and lodging at the Akademie Hotel Karlsruhe.

The fees do not cover travel expenses.

A limited number of fellowships will be available for qualified candidates. The fellowship covers the amount of € 900, which leaves the remaining amount of € 900 to be financed by the applicant or his/her employer. These fellowships are primarily intended for candidates from developing countries. Requests should be motivated.

All applicants are required to provide a short curriculum vitae, which will be used for selection purposes.

The FJOH School considers that the 2013 programme corresponds approximately to 3-4 ECTS credits of post graduate-level course work in Nuclear Engineering.

Selection by the FJOH School organizers is final.

Information

Key dates

The school will start on August 20, 2013, 7:00 pm with a get-together-dinner at the Akademie Hotel Karlsruhe and will end on August 30, 2013, 1:00 pm.

Partial participations are not accepted.

Notification to applicants: June 5, 2013

Questions ? Please contact:

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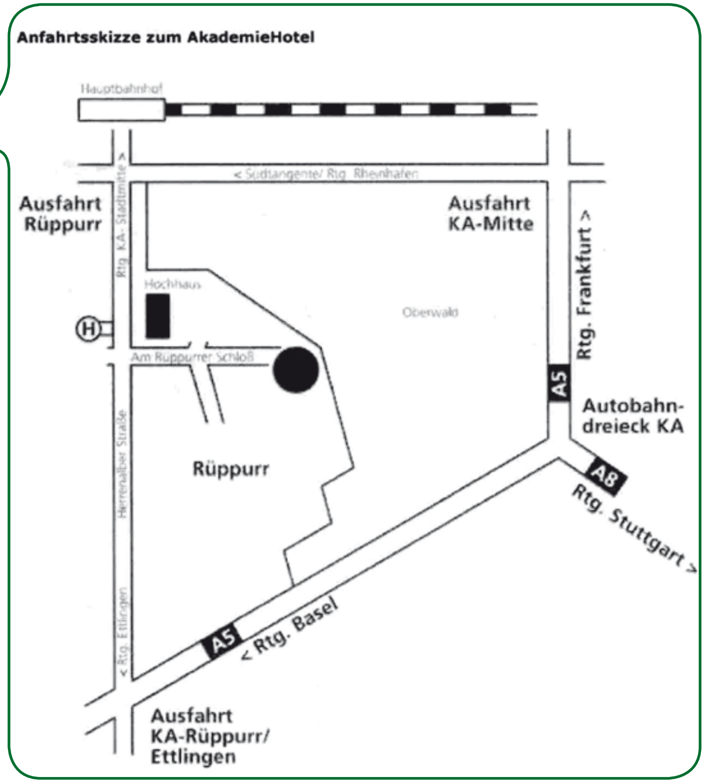
Information

Venue

The School will be held at the Akademie Hotel Karlsruhe, located about 4 km from downtown Karlsruhe, Baden-Württemberg, Germany.

The Akademie Hotel is conveniently accessible by tram from the Karlsruhe central train station.



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Frédéric JOLIOT & Otto HAHN

SUMMER SCHOOL ON NUCLEAR REACTORS

"Physics, fuels and systems"

2013

Jointly organized by the Commissariat à l'Energie Atomique et aux Energies Alternatives (France) and the Karlsruhe Institute of Technology (Germany)

Advanced Nuclear Systems with Transuranium Fuels

Karlsruhe Germany August 20 > 30

Karlsruhe Institute of Technology

cea CADARACHE

Karlsruhe Germany
August 20 > 30

Deadline for application
May 17, 2013

For more information and for application
www.fjohss.eu

PROGRAMME OUTLINE

LECTURERS

ADVANCED NUCLEAR SYSTEMS WITH TRANSURANIUM FUELS

1.	**Introduction and Overview**	**6 h**
1.1.	Transmutation Systems: Motivations and Concepts (2 h)	**Dr. Jean-Marc Cavedon** (PSI, Switzerland)
1.2.	Status of 20+ Years of R&D in Europe: Where do we Stand? (2 h)	**Dr. Dominique Warin** (CEA, France)
1.3.	Design Methodology and Criteria, Safety Considerations, Technological Readiness Assessment (2 h)	**Dr. Kazuo Minato** (JAEA, Japan)
2.	**Fast Critical Reactors and Transmutation**	**6 h**
2.1.	Reactor Concepts and Optimization, ASTRID and other Demonstrations (3 h)	**Dr. Bruno Fontaine** (CEA, France)
2.2.	Core Physics: Specificities, Methods, Validation (3 h)	**Dr. Konstantin Mikityuk** (PSI, Switzerland)
3.	**Transmutation in Sub-critical Accelerator-driven Systems**	**9 h**
3.1.	ADS Concepts: Characteristics, Safety and Demonstrators (2 h)	**Dr. Bernard Carluec** (AREVA, France)
3.2.	Spallation Target: Physics, Materials, Experiments (2 h)	**Dr. Concetta Fazio** (KIT, Germany)
3.3.	Proton Accelerators for ADS and Performance Issues (2 h)	**Prof. Dr. Holger J. Podlech** (Frankfurt University, Germany)
3.4.	Sub-critical Core Physics and Experiments (2 h)	**Dr. Annick Billebaud** (CNRS/LPSC, France)
3.5.	The MYRRHA Demonstrator: From the Conceptual Stage to the Actual Plant Design and Specifications (1 h)	**Prof. Dr. Hamid Aït Abderrahim** (SCK-CEN, Belgium)
4.	**Partitioning and Separation Processes**	**4 h**
4.1.	Aqueous Recycling Technologies for Fuels and Targets (2 h)	**Dr. Robin Taylor** (NNL, UK)
4.2.	Pyro-processing of Spent Fuels (2 h)	**Dr. Hansoo Lee** (KAERI, Japan)
5.	**Advanced Fuels**	**9 h**
5.1.	Fuel Re-fabrication: Minor-actinide Bearing Fuels and Targets (3 h)	**Dr. Joseph Somers** (EC/JRC-ITU, Germany)
5.2.	Ceramic Fuels for MA Homogeneous and Heterogeneous Recycling (3 h)	**Dr. Nathalie Chauvin** (CEA, France)
5.3.	Metallic Fuels for MA Homogeneous and Heterogeneous Recycling (3 h)	**Dr. Rory Kennedy** (INL, USA)
6.	**Ultimate Waste Management**	**4 h**
6.1.	Waste Management: Handling and Transport Issues (2 h)	**Dr. Klaus-Jürgen Brammer** (GNS, Germany)
6.2.	Long-term Waste Forms and Geological Repository (2 h)	**Dr. Claes Thegerström** (SKB, Sweden)
	Seminar	**2 h**
	Societal and Economics Conditions for the Development of Nuclear Systems	**Dr. Harri Tuomisto** (Fortum, Finland)
	Technical visits of Karlsruhe Institute of Technology R&D facilities	

COORDINATION

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DESCRIPTION

2013

This 19th session of the Frédéric Joliot/Otto Hahn (FJOH) Summer School on "Nuclear Reactors Physics, Fuels, and Systems" will be held in Karlsruhe, Germany, from **August 20 to August 30**, 2013.

This year's session is devoted to "Advanced Nuclear Systems with Transuranium Fuels". The course programme addresses the motivation and objectives for the development of such systems, in the context of various local and global fuel management strategies. The progress made over the past 20 years will be described, as well as on-going projects and future plans. Both critical fission reactors and subcritical spallation-source driven systems will be covered, from the standpoint of core and fuel physics, minor-actinide transmutation efficiency, technological feasibility, design criteria, operational and safety constraints. Different lecturers will provide complementary perspectives on each topic. The course will also cover state-of-the-art core and fuel modelling techniques, relevant analysis methods, and the need for experiments and technological demonstrations. Moreover, the FJOH-2013 participants will learn about front-end and back-end fuel cycle considerations, including minor-actinide bearing fuel fabrication, handling and transport, spent fuel reprocessing, and ultimate waste disposition. A seminar will address societal and economics considerations.

This course represents the continuation of the Frédéric Joliot Summer Schools on «Modern Reactor Physics and the Modelling of Complex Systems», which was created in 1995 to promote knowledge in the field of reactor physics, in a broad sense, and the international exchange of teachers, scientists, engineers and researchers. Beginning in 2004, the scope of the School was extended to include scientific issues related to nuclear fuels.

The School's aim is to address the challenges of reactor design and optimal fuel cycles, and to broaden the understanding of theory and experiments. The venues of the FJOH School sessions alternate between Karlsruhe and Aix-en-Provence.

Lecturers are invited from internationally leading universities, research and development laboratories, and industry. The lectures are at a post-doctoral level. They are intended for junior as well as experienced scientists and engineers engaged in the broad field of nuclear sciences, engineering and technologies.

The programme of each school session is defined by the International FJOH Scientific Board (see below).

The Karlsruhe Institute of Technology and the Nuclear Energy Division of CEA jointly organize and sponsor the FJOH Summer School.

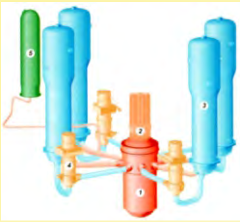
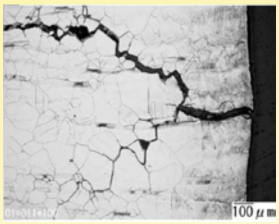
FJOH Scientific Board members

Prof. Jan Blomgren (Vattenfall AB, Sweden)
Dr. Ron Cameron (OECD, International)
Prof. Francisco Fernandez (CSN, Spain)
Prof. Michel Giot (UCL, Belgium)
Prof. Waclaw Gudowski (RIT, Sweden)
Dr. Kevin Hesketh (NNL, UK)
Prof. Jan Leen Kloostermann (Delft Univ., The Netherlands)
Dr. Rudy Konings (EC/JRC-ITU & Delft University, Germany)
Dr. Alex Mueller (CNRS, France)
Dr. Stefan Niessen (AREVA, Germany)
Dr. Daniel Parrat (CEA, France)
Prof. Horst-Michael Prasser (ETHZ, Switzerland)
Prof. Piero Ravetto (Politecnico di Torino, Italy)
Prof. Richard Sanchez (CEA, France)
Prof. Vladimir Slugen (Slovak Univ. of Tech. & ENS, Slovakia)
Dr. Walter Tromm (KIT, Germany)
Dr. Harri Tuomisto (Fortum Power, Finland)
Dr. Luc Vanhoenacker (Tractebel Eng.-GDF-Suez, Belgium)
Prof. David Weaver (University of Birmingham, UK)
Prof. Frank-Peter Weiss (GRS, Germany)

NuCoSS-15

2nd announcement of the
Nuclear Corrosion Summer School

July 5 to 10, 2015 in Bled, Slovenia

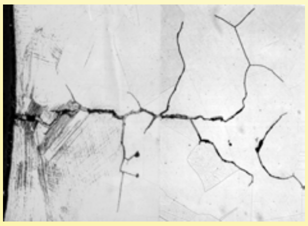



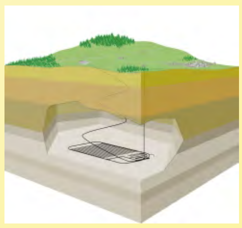
Corrosion is the number one degradation mechanism in the nuclear industry, which can seriously affect plant availability and economics or even challenge the safety.

The summer school is primarily intended for people from nuclear authorities, industry and research organisations who would like to get a comprehensive overview on the field of nuclear corrosion. The programme is designed in a way that networking and a knowledge transfer from experienced experts to the «young generation» is facilitated.

Internationally renowned experts (R.A. Cottis, D. Féron, J. Hickling, D. Engelberg, S. Trevin, C. Padovani, R. Kilian, H.P. Seifert, R.-W. Bosch, J. Matthews, and others) will give lectures on the following topics:

- Electrochemistry and corrosion
- Overview on corrosion in the nuclear cycle
- Corrosion in light water reactor plants (incl. monitoring and mitigation aspects)
- Corrosion in nuclear waste disposals
- Corrosion in Gen IV systems
- Case studies and ageing management
- Advanced technologies to characterize corrosion



Official event of the European Federation of Corrosion

EFC event no. 392

More information is available at: www.zag.si/nucoss

This event is powered by:

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ZAG — ZAVOD ZA GRADBENIŠTVO SLOVENIJE — SLOVENIAN NATIONAL BUILDING AND CIVIL ENGINEERING INSTITUTE

MANCHESTER 1824 — The University of Manchester

EFC WP 4 Nuclear Corrosion

Date: July 5 (evening) to July 10 (morning), 2015

Place: Hotel Jelovica in Bled, Slovenia

EFC event no. 392: Co-organized by EFC Working Party 4 «Nucl. Corr.»

Local organiser: A. Legat, T. Kosec, B. Zajec, and M. Bajt Leban, Slovenian National Building and Civil Engineering Institute (ZAG)

Int. organising committee: D. Féron & F. Martin (CEA), S. Ritter (PSI), F. Scenini (University of Manchester)

Registration fee: 1180.- € for students (PhD or MSc), 1460.- € for all others. The fee includes accommodation (Sun to Fri), all meals & drinks, coffee breaks, lectures with hand-outs (on memory stick), and one social activity.

Registration deadline: **April 20, 2015** (places are limited, »first come, first served»)

For registration and more information see: www.zag.si/nucoss

If you have any questions, please contact: nucoss@zag.si

The support of the following organisations is gratefully acknowledged:

AREVA

CORMET Testing Systems
Solutions for corrosion testing, www.cormet.fi

IPS Ingenieurbüro Peter Schrems
www.ips-jaissle.de

NDA Nuclear Decommissioning Authority

SCK•CEN
STUDIECENTRUM VOOR KERNENERGIE
CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE

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Professional Education on Nuclear Energy

In the ever-changing European and global energy sectors, one thing remains constant: the interest in nuclear power. This interest can be found not only in numerous developed countries, among which several EU Member States, but also in an increasing number of emerging/developing economies which have started to take the potential of nuclear power seriously into account. As a result, the demand for highly educated nuclear engineers and scientists in industry, research, technical safety and governmental organisations is increasing. A highly skilled and up-to-date workforce plays a crucial role in responsibly maintaining the civil nuclear reactor fleet and decommissioning obsolete plants. In addition to this, it is imperative to involve a well-educated workforce in designing and building new nuclear infrastructure and in dealing with radioactive wastes.

Professional Education on Nuclear Energy

Therefore high quality education and training for workforce is essential for the future of the nuclear power sector. In an effort to stimulate and coordinate training in this field, the European Commission has recently brought together 11 leading academic and research institutions in Europe and a range of other stakeholders to create a sustainable lifelong training programme in the field of nuclear fission technology. This co-called GENTLE network offers professionals the opportunity to enrol in the Professional Education on Nuclear Energy, a unique programme designed by Europe's leading experts to meet the needs of nuclear industries, research and technical safety organisations.

An educated, well-trained workforce is essential for the future of the nuclear power sector.

Expertise

The GENTLE network that coordinates the course consist of Delft University of Technology (The Netherlands), Budapest University of Technology (Hungary), the CIRTEN interuniversity consortium for technological nuclear research (Italy), Karlsruhe Institute of Technology (Germany), Technical University of Madrid (Spain), The Belgian Nuclear Research Centre SCK•CEN (Belgium), The University of Manchester (UK), Paul Scherrer Institute (Switzerland), University of Tartu (Estonia), Lappeenranta University of Technology (Finland) and the Joint Research Centre of the European Commission. Learn more about the GENLTE network on gentleproject.eu.

Benefits

- Several large nuclear organisations support the course; participants have the opportunity to create links with the top employers in the nuclear industry.
- Eleven leading European institutes contribute to the curriculum, all supplying their unique specialism.
- The scope of the programme is truly international, with contact days in several countries.
- This modular programme covers all base theoretical and practical aspects regarding nuclear energy. Each module can be attended separately as its content covers the full scope of the module topic.
- The programme offers a hands-on approach, which includes extensive practical training.

Programme

Attending the full programme takes a little bit over one year and consists of five modular parts. All modules can also be followed sepertaly, if this suits your needs better. The first four modules aim to provide the participants with the suitable background and the specific knowledge about Nuclear Energy Systems and their main features through lectures, instructions and site visits. The fifth module is devoted to provide soft skills that are critical in the nuclear sector.

Topics

Module 1 – Understanding nuclear power - Delft University of Technology - June 2015

- Societal, economical and technical perspectives on nuclear energy
- Fundamentals of nuclear science, nuclear chemistry, thermal hydraulics, radiation protection and nuclear reactor physics
- Nuclear fuel cycle and waste management

- Module 2 – Producing energy with nuclear reactors - Karlsruhe Institute of Technology - October 2015
  - Principles of energy generation with nuclear reactors
  - LWR systems for energy generation and conversion including safety systems (PWR, VVER and BWR)
  - Operational aspects of PWR
  - Fundamentals of neutron physical and thermal hydraulic core design (principles, current methods, trends)
  - Dynamic behaviour of LWRs
  - One-day visit of the training reactor of IKE Stuttgart University (experiments, measurements)

Module 3 – Nuclear fuel from ore to waste - Joint Research Centre - Karlsruhe - February 2016

- Fundamentals of actinides chemistry and physics
- Where nuclear fuel comes from?
- How does it behave in the reactor?
- What to do with used fuel nuclear fuel afterwards?
- Existing technologies and future developments

Module 4 – Societal justification, safety and security of nuclear energy - SCK•CEN - Mol - April 2016

- Science, politics and ethics of nuclear technology assessment
- Nuclear safeguards and security aspects
- Nuclear safety aspects (deterministic and probabilistic approaches)
- Nuclear safety culture and methodologies for safety assessment
- Decommissioning of nuclear plants issues

Module 5 – Management systems - CIRTEN - Milan - June 2016

- Quality management principles
- Project management issues
- General soft skills
- Insights into the interaction processes with Safety Authorities and Regulatory Bodies

For more information about the specific dates of the modules we refer to the nuclear energy website.

Target group

The Professional Education on Nuclear Energy course is designed for professionals positioned in industry, consultancy companies, research organisations, (inter) governmental organisations and regulatory bodies. The programme is especially attractive for professionals (e.g. more than 3 years working experience) who have an MSc level degree in a technological/scientific area but who do not have a nuclear engineering background. The programme is open to qualified candidates from all over the world.

Study load

Every module has a workload of 8 ECTS credits. The modules have 80 face-to-face lecture hours combined with 140 hours for preparation, distant learning and homework assignments.

The total programme duration is little bit more than one year and upon successful completion of every individual module, you will receive a certification.

Tuition fee

In 2015 the programme will be offered for the introductory price of € 18,000.00 per participant for the complete programme. Individual modules can be attended individually for a price of € 3,600.00 per module.

These tuition fees cover all necessary costs; the complete study programme, books, access to student facilities, excursions, hotel and all the meals for the programme duration. (Travel arrangements to and from the lecture locations are not included).

www.nuclearenergy.education

You will visit 5 nuclear institutes

The Professional Education on Nuclear Energy offers you inside knowledge from 11 leading nuclear research institutes in Europe. You will have the extraordinary opportunity to visit 5 nuclear centres of expertise and learn firsthand about nuclear energy systems. The remaining partners will join you in these 5 locations to give you the best nuclear education possible.
Module 1 takes place at the Reactor Institute Delft (RID) at Delft University of Technology. Here you will visit a pool-type nuclear reactor, built specifically as a source of neutrons and positrons for fundamental and applied scientific research into areas such as health and sustainable energy. During Module 2, held at the Institute for Nuclear Waste Disposal (INE) of the Karlsruhe Institute of Technology, you will experience facilities to study the geochemical aspects of the long-term safety of nuclear waste disposal, equipped for working with radionuclides of all types including reactor fuels and alpha emitters. Module 3 is led by the JRC Institute for Transuranium Elements (ITU) in Karlsruhe, which is an inspiring location as its laboratories are equipped to deal with all stages of the fuel cycle. Module 4 is held at the Belgian Nuclear Research Centre (SCK•CEN), home to three operational research reactors, one in the process of being decommissioned and an underground laboratory dedicated to the study of potential geological host formations for long-lived and highly active nuclear waste. Finally, Module 5 takes place in Milan at CIRTEN, the joint centre of nuclear expertise of 6 universities in Italy, where you will learn everything about nuclear management systems.

Stakeholders

The stakeholders are in dialogue with the partners to difine the programme content. The stakeholders involved are AREVA (France), CNU (Romania), Eesti Energia (Estonia), ENEN (France), ENS (Belgium), FORATOM (France), NNL (UK), NRG (Netherlands), NUGENIA, SNETP (France), TVO (Finland), Urenco (Netherlands), Westinghouse (Sweden).

Partners

The following partners contribute to the Professional Education on Nuclear Energy programme.

TU Delft | European Commission | Universidad Politécnica de Madrid | SCK•CEN | SCK•CEN ACADEMY FOR NUCLEAR SCIENCE AND TECHNOLOGY | Lappeenranta University of Technology

CIRTEN Consorzio Interuniversitario per la Ricerca Tecnologica Nucleare | MŰEGYETEM 1782 | MANCHESTER 1824 The University of Manchester Dalton Nuclear Institute | KIT Karlsruhe Institute of Technology | Tartu Ülikool Universitas Tartuensis 1632 | PAUL SCHERRER INSTITUT PSI

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info@nuclearenergy.education
www.nuclearenergy.education

24 - 02 - 2015

MODULE 1: Understanding Nuclear Power (TUD)

Main coordinator: Delft University of Technology
Teaching unit: Faculty Applied Sciences, Reactor Institute Delft (RID)
Dates: 1st to 12th of June 2015
ECTS credits: 8
Teaching language: English

Teaching staff:

Module manager: Jan-Leen Kloosterman
Other teachers: Alan Tkaczyk, Meskens Gaston, Peter Schillebeeckx, Jan Heyse, Stefaan Pomme, Marcel Schouwenburg, Stefaan van Winckel, Dennis Bykow, Rudy Konings, Thierry Wiss, Juhani Hyvärinen, Rudy Konings

Main topics: General introduction to nuclear energy (societal, economical and technical point of view). Fundaments in the fields of economics, electricity markets, nuclear science and radiation, radiation shielding, nuclear reactor physics and core thermal hydraulics.

Table 1: Course overview of Module 1 "Understanding Nuclear Power"

Modules	Hours	Responsible Lab	Teacher
1 General introduction to nuclear energy	5	UT	Alan Tkaczyk Meskens Gaston
2 Fundamentals of nuclear science	6	IRRM	Peter Schillebeeckx Jan Heyse Stefaan Pomme
3 Fundamentals of radiation protection	8	TUD	Marcel Schouwenburg
4 Fundamentals of nuclear reactor physics	10	TUD	Jan-Leen Kloosterman
5 Fundamentals of chemistry	4	ITU	Stefaan van Winckel Dennis Bykow Rudy Konings Thierry Wiss
6 Fundamentals of thermal hydraulics	9	LUT	Juhani Hyvärinen
7 Fuel cycle and waste management	5	ITU	Rudy Konings
8 On-site visits	10	TUD	Jan-Leen Kloosterman
9 Learning Tests	2	TUD	Jan-Leen Kloosterman

Teaching Methods *(same for every module):*

MD.1. **Distant learning**. Prepare the subjects you are going to study at the course by watching online-lectures of your lectures at the location or reading some parts of the study literature (30 minutes per lecture hour).
MD.2. **Lectures**. Learning in presentations by the Professors of Nuclear Energy about different topics, processes, methods, etc. The exposition is logically structured with the aim of providing a theory concepts, show the way to solve the different types of problems, point out the stages of the processes and standard procedures, indicate the correct way of using tools and calculations.
MD.3. **On-site visits**. Gain deeper and broader insight into the operation principles and other non-technical aspects (economical, environmental, societal, etc)
MD.4. **Exam**. At the end of each programme week multiple-choice questionnaire will be filled out to test the knowledge received that week.
MD.5. **Homework assignment**. Given study material studied at home with an assignment that will be handed in through mail or e-mail with the module coordinator (per lecture hour: 60 minutes homework, 30 minutes assignment).

Study book list:

General introduction to nuclear energy

- The most updated educational material (based on scientific papers, reports, databases) will be selected on purpose.
- "Nuclear Energy Systems and Concepts" Murray and Holbert (6th Ed., 2013)
- **DOE books (through PDF, online)**

Fundamentals of nuclear science:

- [S&F] Shultis and Faw, "Fundamentals of Nuclear Science and Engineering", CRC Press, 2007.

Fundamentals of radiation protection:

- J.E. Turner, "Atoms, Radiation and Radiation Protection", Wiley, 1985.

Fundamentals of chemistry:

- DOE / slides

Fundamentals of thermal hydraulics:

- [T&K] Todreas and Kazimi, "Nuclear Systems Volume I: Thermal Hydraulic Fundamentals", CRC Press, 2010.

Fundamentals of nuclear reactor physics:

- [D&H] Duderstadt and Hamilton, "Nuclear reactor Analysis", Wiley, 1976.

<u>Fuel cycle and waste management:</u>

- “Nuclear Energy Systems and Concepts” Murray and Holbert (6th Ed., 2013)

Reading list for further information:

<u>Fundamentals of nuclear science:</u>

<u>Fundamentals of chemistry:</u>

- K.L. Murty, I. Charit, “An introduction to nuclear materials”, Wiley, 2013.
- C.C. Lin, “Radiochemical Technology in Nuclear Power Plants, ANS, 2013.

<u>Fundamentals of thermal hydraulics:</u>

<u>Fundamentals of radiation protection:</u>

<u>Fundamentals of nuclear reactor physics:</u>

- E.E. Lewis, “Nuclear Reactor Physics”, Academic Press, 2008.

<u>Fuel cycle and waste management:</u>

- N. Tsoulfanidis, “The Nuclear Fuel Cycle”, ANS, 2013.
- I. Crossland, Ed., “Nuclear Fuel Cycle Science and Engineering”, Woodhead Publishing, 2012.

Table 2: Lecture overview of Module 1 "Understanding Nuclear Power"

	MODULE 1: Understanding Nuclear Power	**book**	**Hours**	**Partner**
1	**General introduction to nuclear energy**		**8**	**UT, SCK**
	World energy demand and supply	TBD	1	UT
	European energy demand and supply	TBD	1	UT
	Role of nuclear energy	TBD	1	UT
	Economic aspects of nuclear energy (methods)	TBD	1	UT
	Environmental aspects of nuclear energy	TBD	1	UT
	Uranium resources	TBD	1	UT
	Nuclear Energy in its socio-political context	TBD	2	SCK
2	**Fundamentals of nuclear science**		**8**	**IRRM, UMAN distance learning**
	Nuclear and atomic models	S&F	2	IRRM
	Nuclear energetics and Radioactive decay	S&F	2	IRRM
	Radiation interaction with matter	S&F	2	IRRM
	Nuclear reactions (fission, capture, scattering)	S&F	2	IRRM
3	**Fundamentals of radiation protection**		**12**	**TUD**
	Types of ionizing radiation	Turner	1	TUD
	Biological effects of radiation (incl dosimetry)	S&F	1	TUD
	Shielding of gamma-rays and neutrons	Turner	2	TUD
	Measurement of radiation	Turner	2	TUD
	Legal framework on radiation protection	Turner	2	TUD
	Exercises and training (PC shielding program)		4	TUD
4	**Fundamentals of chemistry**		**12**	**ITU**
	General chemistry	M&C	2	ITU
	Radiation and environment	M&C	2	ITU
	Chemistry of actinides	M&C	2	ITU
	Reactor materials fundamentals	M&C	6	ITU
5	**Fundamentals of thermal hydraulics**		**8**	**LUT**
	Single-phase and two-phase flows (incl fluid conservation equations and approximations)	T&K	4	LUT
	Turbulence and turbulent heat transfer	T&K	2	LUT
	Boiling and condensation heat transfer	T&K	2	LUT
6	**Fundamentals of nuclear reactor physics**		**14**	**TUD**
	Nuclear fission reactor priniciples	D&H	1	TUD
	Neutron cycle, K_{eff}, Neutron diffusion theory (one group, multigroup)	D&H	1	TUD
	Reactivity feedback effects	D&H	2	TUD
	Nuclear reactor kinetics	D&H	2	TUD
	Safety fundamentals of nuclear reactors	D&H	2	TUD
	Fuel management (burnup, reloading)	D&H	2	TUD
	Exercises and training		2	TUD
	Visit HOR (TU Delft Research Reactor)		2	TUD
7	**Fuel cycle and waste management**		**8**	**ITU**
	Front end		4	
	Back end		4	
8	**On-site visit (one out of three)**		**8**	**TUD**
	NPP+waste storage facility (Borssele or Doel) *Enrichment plant (Urenco)* *High Flux Reactor (Petten) + Moly plant*			
9	Learning test		**2**	**TUD**
	TOTAL		**80**	

Table 3: Core learning outcomes in Module 1 “Understanding Nuclear Power”

	Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
General introduction to nuclear energy	K1. Rank the various energy carriers in order of importance for the global energy supply K2. Rank countries in order of energy consumption and explain the relation between economic welfare and energy consumption K3. Explain the economical methods used to calculate the cost estimates of our energy supply and of nuclear energy K4. Describe the invisible (indirect) costs of various energy supply options K5. Describe the environmental aspects of nuclear energy and compare these with other energy options K6. Describe the size and origin of global uranium resources	Compare nuclear energy option with other energy options on aspects of resource availability, security of supply, economical aspects, etc Estimate the costs of nuclear energy and compare these with other options, also taking into account indirect costs	C1.
Fundamentals of nuclear science	K7. Describe the classical atomic model based on the shell structure of electrons and the atom nucleus K8. Know the fundamental forces in play in the nucleus K9. Explain the concept of binding energy and the origin of fission energy K10. Write down the physics laws to describe radioactive decay K11. Explain the concepts of microscopic and macroscopic cross sections and understand its behavior as a function of energy K12. List and explain the nuclear reactions between neutrons and nuclei K13. Describe the principles of fission chain reaction	S1. Apply radioactive decay laws to calculate activities of mother and daughter nuclides S2. Identify which nuclides are fissile S3. Identify which nuclide mixtures can potentially lead to a fission chain reaction S4. Compare microscopic cross sections, calculate macroscopic cross sections of nuclide mixtures, and identify dominant reaction types.	

Fundamentals of chemistry	K14. Describe the origin of natural background radiation K15. Explain the different types of chemical bonding (ionic, covalent, metallic) K16. Explain the chemical behavior of actinides in view of their electronic structure K17. Illustrate the role of redox reactions in actinide series K18. Predict the environmental behavior of actinides species K19. List the requirements for nuclear structural materials K20. List the requirements for nuclear fuel materials K21. List the requirements for moderator materials K22. Describe the mechanisms of neutron interaction with materials and the effects of neutron interaction on materials	S5. Compare dose rates with natural background dose levels S6. Predict the environmental behavior of actinide species S7. Categorize new materials as suitable nuclear materials for either structures, fuel or moderator	
Fundamentals of thermal hydraulics	K23. Describe the various methods for heat transport K24. Describe the thermal-hydraulic characteristics of nuclear reactors cores K25. Explain the fundamental conservation laws for one and two phase fluids K26. Describe the characteristics of turbulent heat transfer K27. Describe the characteristics of boiling heat transfer and of condensation heat transfer		

Fundamentals of radiation protection	K28. List and explain the various types of ionizing radiation and the main differences between them K29. List and explain the biological effects of ionizing radiation with tissue K30. List and explain the physics interaction mechanisms between radiation and matter K31. Explain the principles of gamma ray shielding K32. Understand the concept of buildup factor K33. Know the effects of multi-layered shields for effective gamma-ray shielding K34. List good gamma ray shielding materials K35. Describe the principles of neutron shielding K36. List properties of neutron shielding materials K37. Explain the effects of multi-layered shields for effective neutron shielding K38. Explain the shielding approach for mixed radiation fields K39. List the limits for radiation levels for various groups of people	S8. Calculate the gamma ray attenuation of shields as a function of material composition and thickness with both analytical methods and with point-kernel shielding computer programs. S9. Calculate the required radiation shielding of experiments with radioactive sources S10. Assess the accuracy of calculation shielding methods and identify when to use advanced shielding programs	C2. Communicate with colleagues and the public about radiation levels and the effects of radiation on humans, food and equipment.

Fundamentals of nuclear reactor physics	K40. Describe the neutron life cycle in a thermal reactor and explain the six-factor formula K41. Explain the meaning of neutron flux and current K42. Explain the principles of neutron diffusion theory and the approximations and limitations of this approach K43. Write down the neutron diffusion equations K44. Explain the concept of reactivity and know the means of reactivity control in nuclear reactors (control rods, chemical shim, soluble boron, etc) K45. Explain the origin of delayed neutrons and their importance for nuclear reactor control K46. Write down the point-kinetics equations K47. Understand the safety philosophy of nuclear reactors K48. Explain the initiating event and scenario of the Fukushima Daiichi accident K49. Understand the nuclide composition changes during burnup and their effects on reactivity K50. Explain the principles of fuel management for reactivity control	S11. Identify the effect of nuclide composition and geometry changes on the reactivity of a nuclear reactor core S12. Calculate the neutron flux distribution in simple reactor geometries based on neutron diffusion theory S13. Apply the point-kinetics equations for various transients to evaluate and understand time-dependent excursions in nuclear reactors S14.	
Fuel cycle and waste management	K51. Describe the goal and operation principles of the front-end steps of the nuclear fuel cycle K52. Describe the different uranium mining methods and the pros and cons of each K53. List the uranium enrichment methods K54. Describe the strategies for the back end of the nuclear fuel cycle (open cycle, closed cycle, transmutation, etc) K55. Describe the goal and operation principles of each step in the back-end of the fuel cycle K56. List the various options for geological storage of nuclear waste K57. Describe the various physical, chemical, and biological processes that determine the performance case of geological repositories	S15. Compare the different fuel cycle strategies and evaluate the effects on each stage of the nuclear fuel cycle	C3. Communicate with the public and with colleagues about nuclear fuel cycle strategies and nuclear waste storage options

On-site visit	K58.	S16.	C4. Communicate with operators of nuclear facilities to gain deeper and broader insight into the operation principles and other non-technical aspects (economical, environmental, societal, etc)

Are you?

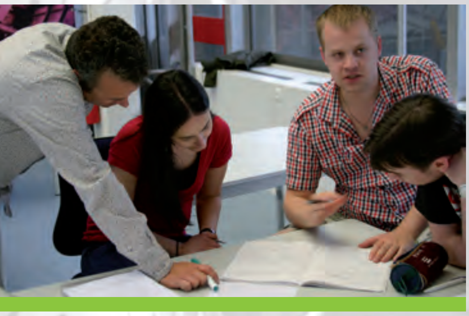
Involved in nuclear fusion development?
Intrigued by the challenges of fusion?
Lacking the basic education in this field?

Then register for the fusion crash course!

For whom?

Engineers involved in ITER
Managers or engineers in fusion industry
Science journalists and scientific advisers
Administrative and project staff in ITER
Scientists from adjacent fields
Newcomers in the field

We provide you with a kick start in this challenging field!



What?

Tailor made 3 days fusion crash courses
Adapted to professionals in the field
Small groups: 5-10 participants maximum
Experienced lecturers
Near Eindhoven, The Netherlands

Course Dates

October 27 - October 29, 2014
April 15 - April 17, 2015
October 21 - October 23, 2015

Subsequent courses are planned for 2015, see our website for more information: www.fusionacademy.eu

Fee: 1950 EUROS (incl. material, accommodation, full catering and VAT)

In-company training / custom dates
on request: info@fusionacademy.eu

Fusion Academy

Register now at:
www.fusionacademy.eu

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- To foster and strengthen the relationships between universities, nuclear research laboratories, industry and regulatory bodies.

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60 institutions from 22 countries* are currently members of ENEN Association.

Contacts

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Nadia Nowacki: nadia.nowacki@cea.fr

ENEN Association

Institut National des Sciences et Techniques Nucléaires

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Tel. + 33 1 69 08 97 57

Email: sec.enen@cea.fr

INSTN BUILDING AT SACLAY
©CEA/F. VIGOUROUX

2014 - Réalisation: graph.frad@gmail.com

*AUSTRIA, BELGIUM, CZECH REPUBLIC, FINLAND, FRANCE, GERMANY, GREECE, HUNGARY, ITALY, JAPAN, POLAND, ROMANIA, RUSSIA, SLOVAKIA, SLOVENIA, SOUTH AFRICA, SPAIN, SWEDEN, SWITZERLAND, THE NETHERLANDS, UKRAINE, UNITED KINGDOM.

INTERNATIONAL COURSE
GENERATION IV: NUCLEAR REACTOR SYSTEMS FOR THE FUTURE
2014 – FRANCE

Design of Generation 4 fast neutron reactors ©P.Stroppa/CEA

SEPTEMBER 15th – 19th, 2014

Outline Programme

Objectives

The general objective is to provide participants with an up-to-date, basic knowledge on the six concepts selected for the 4th generation of nuclear systems (SFR, LFR, GFR, V/HTR, SCWR, MSR).

The trainees will be able to:

- Describe the main characteristics of each concept, and formulate their design, performance and safety aspects,
- Discuss the technical challenges they are faced with for future development.

Target participants

Professionals, researchers and students with an interest in a global view on the 4th generation of nuclear reactors.

Course contents

Generation IV International Forum (GIF) and 4th generation systems

- General context, evaluation criteria, the six concepts selected
- Increased performance for energy conversion: innovative cycles
- Materials issues and development of advanced components
- Safety aspects of 4th generation reactor concepts

Sodium-cooled Fast Reactors (SFR)

- Principles, past and existing reactors, and background knowledge
- SFR core design, performance and safety
- The choice of sodium coolant: impact on design and operation
- The ASTRID prototype reactor

High Temperature and Very High Temperature Reactors (HTR and VHTR)

- Historical development of HTRs
- HTR core physics

Gas-cooled Fast Reactors (GFR)

- GFR core and system design, preliminary safety evaluation
- The ALLEGRO demonstration reactor

Lead-cooled Fast Reactors (LFR)

- Status of LFR development

Supercritical Water Reactors (SCWR)

- SCWR principles, characteristics and challenges

Molten Salt Reactors (MSR)

- Physics of MSR in the thorium fuel cycle

Fuel cycle of 4th generation systems

- Closed nuclear fuel cycle and transmutation

Information

Methods and Venue

Lecturers are international experts on Generation IV systems.
The programme includes tutorials aimed at developing the capability of participants for pre-designing innovative reactors.
The number of participants is limited to 20. Courses are given in English at the National Institute for Nuclear Sciences and Technology (INSTN), located at the CEA Saclay Centre (20 km south of Paris).

Fees

1) Course rate: Lectures, documentation, shuttle service from Paris 13e (Place d'Italie) to Saclay, lunches, coffee breaks and a social event (no accommodation).

2) Full package rate: Lectures, documentation, accommodation in a 3 star hotel in Paris, shuttle service to Saclay, lunches, coffee breaks and a social event.

Course registration

To get the registration form, please contact: Nadia Nowacki (nadia.nowacki@cea.fr).

Registration constitutes a commitment to attend all lectures.
Participants will receive an attendance certificate at the end of the course.

Registration deadline
September 1st, 2014


Gas cooled reactor ©CEA/DEN


GFR pin-type fuel cladding ©CEA/DEN


ASTRID SFR prototype reactor ©CEA/DEN

Location: Saclay, France
Duration: 1 week

Date: September 15th – 19th, 2014

Registration fee:

1) Course only:
- Full rate: €2550
- ENEN member: €2040
- Student: €1275

2) Full package (course and accommodation):
- Full rate: €3480
- ENEN member: €2970
- Student: €2205

Language: English

For further information or to obtain a registration form, please contact:

Organizer:
Nadia NOWACKI
nadia.nowacki@cea.fr

Programme manager:
Claude RENAULT
claude.renault@cea.fr

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CEA/Saclay
F-91191 Gif-sur-Yvette Cedex
FRANCE
Tel.: +33 1 69 08 97 57
http://www.enen-assoc.org
http://www-instn.cea.fr

JUNE 2014

INTERNATIONAL COURSE

GENERATION IV: Nuclear reactor systems for the future

INSTN, Saclay, France

September 15-19, 2014

REGISTRATION FORM

NAME:	FIRST NAME	
MALE ☐ FEMALE ☐	NATIONALITY:	
COMPANY (NAME, ADDRESS):		
PHONE OFFICE:	MOBILE	
EMAIL:		
TITLE/POSITION:		
FOOD RESTRICTION (vegetarian, no pork, no seafood, allergy…)		
DATE OF BIRTH:		
BIRTHPLACE (City/Country):		
HOME ADDRESS:		
PASSPORT NUMBER:	ISSUED AT:	
DATE OF ISSUE:	DATE OF EXPIRATION:	
I hereby commit myself to attend all lecturers and technical visits. ☐		
I enclosed a proof of payment for registration fee, YES ☐ NO ☐ (should be sent 3 weeks before the opening course)		
*Course only €2550 ☐	ENEN MEMBER €2040 ☐	STUDENT€1275 ☐
**Full package €3480 ☐	ENEN MEMBER €2970 ☐	STUDENT €2205 ☐
PASSPORT ENCLOSED: ☐ the registration form should be accompanied of the copy of passport		
DATE:	SIGNATURE	
Please return the form with the copy of your passport to: nadia.nowacki@cea.fr		

***Fee Covers**: *Course only: Lectures, documentation, shuttle service from Paris 13e (Place d'Italie) to Saclay, Lunches, coffee breaks and a social event(no accommodation)*

***Full package: Lectures, documentation, accommodation in a 3 star hotel in Paris, shuttle service to Saclay, lunches, coffee breaks and a social event.*

Summer School of Reactor Physics 2014

Summer School in Reactor Physics is a one week educational program on cross-cutting topics of reactor physics. It is aimed at students and researches from the nuclear field. The trainees will revise the necessary theoretical background, but the program will mainly focus on reactor physics experiments. The experiments will be carried out on the LR-0 light water reactor. The course is designed not only to enhance practical experience but also to provide specific knowledge for future employment in the field of nuclear energy. The trainees will obtain a certificate upon successful completion of the course.
The event also brings opportunity to meet people from different part of the world. Apart from that there will be special time dedicated to networking and meeting our HR responsible who will inform about the company current and future job possibilities.

25 to 29 August 2014

Program

- Gamma and neutron detection;
- Core characteristics measurement;
- Reactor start-up and operation,
- Performing basic critical experiment and reactivity coefficient calculation;
- Spectroscopy related to reactor LR-0 measurement;
- Nuclear safety;
- Networking, current and future job offer;
- Special event.

Teaching consists of morning lecture and afternoon experimental periods.

How to register
More information including registration form you can find here. Please send email to training@cvrez.cz for further information.

Prerequisites
Knowledge of mathematics (basic use of differential calculus). Knowledge of selected Physics disciplines (elementary mechanics, electronics and structure of atoms). Lectures will be carried out in English.

Centrum výzkumu Řež s.r.o.
Research Centre Rez

Contact
Centrum vyzkumu Rez
Hlavni 130
250 68 Husinec-Rez
Czech Republic
phone: +420 266 172 398
e-mail: training@cvrez.cz

ÚJV Group

Information

METHODS AND VENUE

Conferences and visits will be presented by skilled experts coming from the ANDRA AREVA, CEA, EDF, IAEA and IRSN.

During the week of the seminar, one day will be devoted to conferences and 4 days to technical visits with presentations as appropriate.

The number of participants is limited to 20. Courses are given in English at the National Institute for Nuclear Sciences and Technology (INSTN), located at the CEA Saclay Centre (20 km south of Paris).

FEES

Full package rate: Lectures, documentation, accommodation in a 3 star hotel in Paris and during the tour of nuclear installations, TGV train first class tickets, shuttle service to Saclay, lunches, the coffee breaks and the dinners during the tour.

COURSE REGISTRATION

To get the registration form, please contact: Nadia Nowacki (nadia.nowacki@cea.fr).

Registration constitutes a commitment to attend all lectures. Participants will receive an attendance certificate at the end of the course.

Payment should be made two weeks before the opening course at the latest by bank-to-bank transfer to the CEA. Information and IBAN in the registration form. The proof of payment is requested in your inscription.

Registration deadline

June 9th, 2014

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60 institutions from 22* countries are currently members of ENEN

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Secretary General
European Nuclear Education Network Association
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F-91191 Gif-sur-Yvette Cedex, France
Tel +33 1 69 08 97 57
Fax +33 1 69 08 99 50
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*AUSTRIA, BELGIUM, CZECH REPUBLIC, FINLAND, FRANCE, GERMANY, GREECE, HUNGARY, ITALY, JAPAN, POLAND, ROMANIA, RUSSIA, SLOVAKIA, SLOVENIA, SOUTH AFRICA, SPAIN, SWEDEN, SWITZERLAND, THE NETHERLANDS, UKRAINE, UNITED KINGDOM

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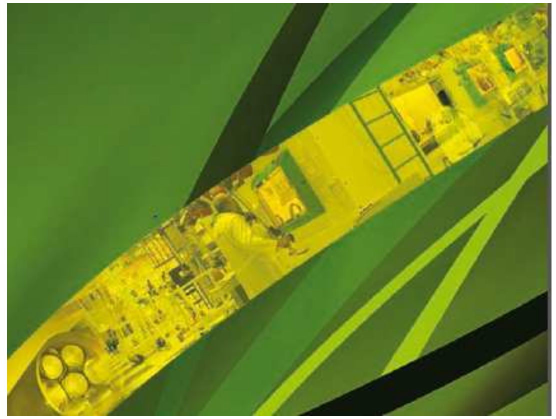
INTERNATIONAL COURSE

NUCLEAR WASTE MANAGEMENT

2014 – FRANCE



Installation CHICADE © CEA/P.Dumas
Container storage © CEA/A.Gonin

07-11 July 2014

INSTN – CEA Saclay, France

Outline Programme

MAIN GOAL

The aim of this seminar is to give an overview on the nuclear waste management from the French nuclear power plant and its R&D along the nuclear applications. The main objective of the seminar is to know the technologies for each type of nuclear waste, depending on their type and activity :

- To give an overview of the law applied to the French nuclear waste management and the associated safety aspects;
- To present the categories of nuclear waste produced by the French nuclear industry;
- To present the activities on solid and liquid nuclear waste treatment and conditioning;
- To present the inventory, characterization, management of technological waste, treatment and conditioning of waste;
- To identify the origin, the nature, the volumes and flux of nuclear waste;
- To describe the nuclear waste management options;
- To know the specific issues of waste conditioning ;
- To have a general background on decommissioning techniques and issues.

Nuclear measurement on waste package © CEA/M. Faugère

Container storage © CEA/A.Gonin

TOPICS

The seminar provides the concepts and the data with regard to the dismantling operation, including :

- General law which regulates the nuclear waste management;
- French regulatory and safety aspect;
- Inventory and origin of effluent and waste;
- Overview on the economic aspect;
- Some technical aspects :
  - Waste from treatment of used fuel;
  - Waste from decommissioning, cleaning up and dismantling;
  - Waste package and characterisation;
  - Conditioning, packaging and control;
  - Nuclear waste disposal;
  - Nuclear waste storage.

VISITS (subject to acceptance)

Several technical visits are planned for a comprehensive view of the French experience on nuclear waste management :

- **ATALANTE:** the treatment and conditioning of Long Live High Activity Waste (LLHAW).
- **CHICADE:** the low level activity waste (LLW) and intermediate level activity waste (ILW) characterisation and control.
- **CASCAD:** the dry storing for irradiated fuel.
- **SAGD:** the treatment of solid nuclear waste in CEA-Saclay Nuclear Research Center.
- **STTL:** the treatment of liquid nuclear waste in CEA-Saclay Nuclear Research Center.
- **AUBE:** the storage of LLW-ILW.
- **MORVILLIERS:** the storage of very low level waste (VLLW).
- **Na – FNR** (PHENIX): Phenix R&D FNR in the field of the long-lived nuclear Waste management.

CEA Valrho/Phénix ©CEA/A.Gonin

Some technical presentations are provided by experts on visit sites.

Information

Location: Saclay, France

Duration: 1 week

Date: **July 7th – 11th, 2014**

Registration fee: **Full package (course and accommodation):**

- Full rate: €3700
- ENEN member: €3110
- Student: €2225

Language: English

For further information or to obtain a registration form, please contact:

The Organizer :

- Nadia Nowacki
- email: nadia.nowacki@cea.fr

or

The Programme manager :

- Hervé Golfier
- email: herve.golfier@cea.fr

or

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CEA/Saclay
F-91191 Gif-sur-Yvette Cedex France
Tel.: +33 1 69 08 30 92
Fax: +33 1 69 08 77 82
http://www.enen-assoc.org
http://www-instn.cea.fr

REGISTRATION FORM

INTERNATIONAL COURSE,

NUCLEAR WASTE MANAGEMENT

Saclay, FRANCE, July 7th – 11th, 2014

Mrs, Miss, Mr:
Name:
First name:
Company (name):

Address&Country:
Title / Position:

Phone:
E-mail & Mobile:

Food restrictions (i.e. vegetarian, vegan, no pork, no seafood, allergy):

ADDITIONAL INFORMATION FOR SITE ENTRY :

Date of birth:

Birthplace (City / Country):

Nationality:

Home address:

Passport number:

Issued at:
Date of issue:
Date of expiration:

I hereby commit myself to attend all lecturers and technical visits
The payment of the fee should be made 3 weeks before the opening at the latest (please wait your invitation before to proceed to the payment):

Full package (course and accommodation)

FULL RATE €3700 ☐

ENEN MEMBER €3110 ☐

STUDENT RATE €2225 ☐

REGISTRATION DEADLINE : JUNE 9th, 2014

Date: Signature

In order to proceed to your registration, please send the form completed with your copy of passport by email to: Nadia.nowacki@cea.fr

IMPORTANT INFORMATION: Please wait your invitation letter before to proceed to the payment of the fee and to book your travel to France.
All registration are classified by their date of arrival and accepted if your inscription includes (the registration form+your copy of passport)

Information

METHODS AND VENUE

Conferences and visits will be presented by skilled experts coming from the ANDRA AREVA, CEA, EDF and IRSN.

During the week of the seminar, one day will be devoted to conferences and 4 days to technical visits with presentations as appropriate.

The number of participants is limited to 20. Courses are given in English at the National Institute for Nuclear Sciences and Technology (INSTN), located at the CEA Saclay Centre (20 km south of Paris).

FEES

Full package rate: Lectures, documentation, accommodation in a 3 star hotel in Paris and during the tour of nuclear installations, TGV train first class tickets, shuttle service to Saclay, lunches, the coffee breaks and the dinners during the tour.

COURSE REGISTRATION

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Registration constitutes a commitment to attend all lectures. Participants will receive an attendance certificate at the end of the course.

Payment should be made two weeks before the opening course at the latest by bank-to-bank transfer to the CEA. Information and IBAN in the registration form. The proof of payment is requested in your inscription.

Registration deadline

June 2nd, 2014

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E-mail sec.enen@cea.fr

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INTERNATIONAL COURSE

DISMANTLING EXPERIENCE OF NUCLEAR FACILITIES

2014 – FRANCE

Decommissioning of R&D Hot cells laboratory CYRANO © CEA/PHOTO
Nuclear measurements during dismantling of pulsed columns facility© CEA/PHOTO

June 30th – July 04th,2014

INSTN – CEA Saclay, France

cea

enen

Outline Programme

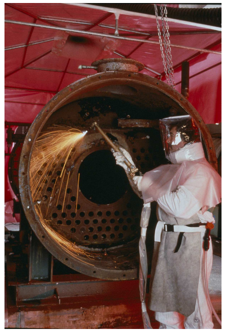
MAIN GOAL

The aim of the seminar is to give an overview of the French experience on dismantling. The information is based on appropriate presentations made by experts and illustrative visits of facilities under dismantling.

The objective of the seminar is to acquire the knowledge which integrates capitalisation from dismantling experience of several types of nuclear facilities and the associated safety aspects :

- ♦To give an overview of dismantling in France (CEA, EDF, AREVA);
- ♦To compare several decommissioning scenarii;
- ♦To present the regulatory and safety aspects;
- ♦To identify the issues of decommissioning;
- ♦To have a general background on dismantling techniques and issues.

This training session can be combined with the training session on "Nuclear waste management" for a comprehensive approach.



BRENNILIS reactor-Pipe cutting operation ©CEA

Decommissioning of R&D Hot cells laboratory CYRANO ©CEA

TOPICS

The seminar provides the concepts and the data with regard to the nuclear waste management, including :

- ♦General overview on dismantling in France;
- ♦Decommissioning scenario;
- ♦Decommissioning issues;
- ♦Recent technical and technological issues;
- ♦Dismantling techniques;
- ♦French regulatory and safety aspects in decommissioning;
- ♦Experience feedback.

VISITS (subject to acceptance)

Several technical visits are planned for a comprehensive view of the French experience on decommissioning and dismantling :

- ♦R&D Hot cells laboratory (CEA);
- ♦Gas Cooled Reactor (EDF Bugey 1);
- ♦Spent fuel reprocessing plant (AREVA NC/CEA-Marcoule);
- ♦Facilities and Technical plateform (R&D laboratories, Graphite/gas reactors…) (CEA).
- ♦Na – FNR (Creys-Malville reactor): FNR under dismantling.

Some technical presentations are provided by experts on visit sites.

Nuclear measurements during dismantling of pulsed columns facility ©CEA

CEA Valrho/Phénix ©CEA/A.Gonin

Information

Location: Saclay, France

Duration: 1 week

Date: **June 30th – July 04th, 2014**

Registration fee: **Full package (course and accommodation):**

- ➢ Full rate: €3700
- ➢ ENEN member: €3110
- ➢ Student: €2225

Language: English

For further information or to obtain a registration form, please contact:

The Organizer :

- ➢ Nadia Nowacki
- ➢ email: nadia.nowacki@cea.fr

or

The Programme manager :

- ➢ Hervé Golfier
- ➢ email: herve.golfier@cea.fr

or

ENEN – INSTN
CEA/Saclay
F-91191 Gif-sur-Yvette Cedex France
Tel.: +33 1 69 08 30 92
Fax: +33 1 69 08 77 82
http://www.enen-assoc.org
http://www-instn.cea.fr

REGISTRATION FORM

INTERNATIONAL COURSE,

DISMANTLING EXPERIENCE OF NUCLEAR FACILITIES

Saclay, FRANCE, June 30th – July 4th, 2014

Mrs, Miss, Mr:
Name:
First name:
Company (name):

Address&Country:
Title / Position:

Phone:
E-mail & Mobile:

Food restrictions (i.e. vegetarian, vegan, no pork, no seafood, allergy):

ADDITIONAL INFORMATION FOR SITE ENTRY :

Date of birth:

Birthplace (City / Country):

Nationality:

Home address:

Passport number:

Issued at:
Date of issue:
Date of expiration:

I hereby commit myself to attend all lecturers and technical visits
The payment of the fee should be made 3 weeks before the opening at the latest (please wait your invitation before to proceed to the payment):

Full package (course and accommodation)

FULL RATE €3700 ☐

ENEN MEMBER €3110 ☐

STUDENT RATE €2225 ☐

REGISTRATION DEADLINE : JUNE 2nd, 2014

Date: Signature

In order to proceed to your registration, please send the form completed with your copy of passport by email to: Nadia.nowacki@cea.fr

IMPORTANT INFORMATION: Please wait your invitation letter before to proceed to the payment of the fee and to book your travel to France.
All registration are classified by their date of arrival and accepted if your inscription includes (the registration form+your copy of passport)

TALISMAn

TALISMAN – CEA Marcoule Summer School 2014 *and Plenary Meeting*

Actinide Chemistry for Future Fuel Cycle

15-20 June 2014 – Marcoule, France

The School (15-18 June 2014)

Every two years, CEA organises a Summer School on Actinides Sciences, supported by the ACTINET and now TALISMAN Network. In 2010, the Summer School focused on the innovation in analytical sciences for actinides. In 2012, it was co-organised with NNL and Univesity of Manchester and closely associated to the Plutonium Future Conference.
In 2014, the School is back to CEA Marcoule and focuses on actinides chemistry for future fuel cycles, addressing the three scopes of TALISMAN: actinide chemistry for separation, actinide materials and actinides in the environment. The School is split into three activities: courses, demonstrations (at ATALANTE and ICSM) and general lectures.
The participants to the School are invited to attend the TALISMAN Plenary Meeting, following the School
The courses will start on Sunday 15th morning

The Plenary Meeting (19-20 June 2014)

This meeting will allow you to meet the TALISMAN consortium, to better know the Pooled Facilities and have an illustration of the research performed within the TALISMAN Joint Research Projects. More details on the website

Cost and Accomodation

The fees (250€) cover the accomodation including breakfast (Hotel in Avignon) from Saturday 14th to Saturday 21st of June, the lunches and coffee breaks from Sunday 15th to Friday 20th, the Plenary Diner and the transportation between Avignon and Marcoule

Application and Registration

Only a limited number of applications can be accepted (42). Please, fill the online pre-registration form to help the selection committee to evaluate your candidature (deadline February 28th). Selction results will be communicated on March 7th. You will then have to finalize your registration by March 21st. To register see TALISMAN website

Preliminary Program

Courses

Actinide chemistry in solution	*A. Gelis (ANL)*
Chemistry of polymetallic assemblies of actinides	*M. Mazzanti (CEA/DSM/INAC)*
Thermodynamic of actinides (aqueous and pyro)	*MC Charbonnel/J.Serp (CEA/DEN/DRCP)*
Multi scale modelling in chemistry – Molecular dynamics and mesoscopic modelling	*Ph Guilbaud – JF Dufrêche (CEA/DEN/DRCP – ICSM)*
Actinide materials characterization	*D. Shuh (Berkeley)*
Radioanalytical chemistry	*Jan John (CTU)*
Review of liquid/liquid separation processes	*(CEA/DEN/DRCP)*
From solution to solid	*(CEA/DEN/DRCP)*
Link between fuel fabrication/irradiation in reactor/dissolution	*ICSM*
Behaviour of the actinides in the environment	*R. Ewing (DOE) (TBC)*

Demonstrations

NMR, Calorimetry, Crystallography	LN1-ATALANTE
Environmental Scanning Electron Microscopy	ICSM
EXAFS spectra exploitation	Room

Evening Lectures

Actinide recycling for a sustainable nuclear energy

Comparison nuclear fuel cycles from the environmental impact point of view

Actinide History (TBC)

Plenary Meeting: see TALISMAN website

cea

Organizing Committee: Stéphane Bourg, Christophe Poinssot, Philippe Moisy, Nicolas Dacheux, Mariette Ferrier, Bastien Duplantier

Contact : CEA/DEN/MAR/DRCP, Bat 400, CEA Marcoule, BP17171, 30207 Bagnols sur Cèze, France