

European Master in Nuclear Energy (EMINE).

EUROPEAN MASTER IN NUCLEAR ENERGY (EMINE), DEVELOPED IN THE FRAMEWORK OF THE EUROPEAN INSTITUT OF INNOVATION AND TECHNOLOGY, KICINNOENERGY.

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- Set up in March 2008 by **the European Parliament and Council**
- **Mission Statement**
 - To increase European sustainable growth and competitiveness by reinforcing the innovation capacity of the EU

- The KICs
 - The **Knowledge and Innovation Communities (KICs)** created by the EIT are the ones bringing together the “knowledge triangle” (business, research & higher education) in thematic partnerships



KIC InnoEnergy

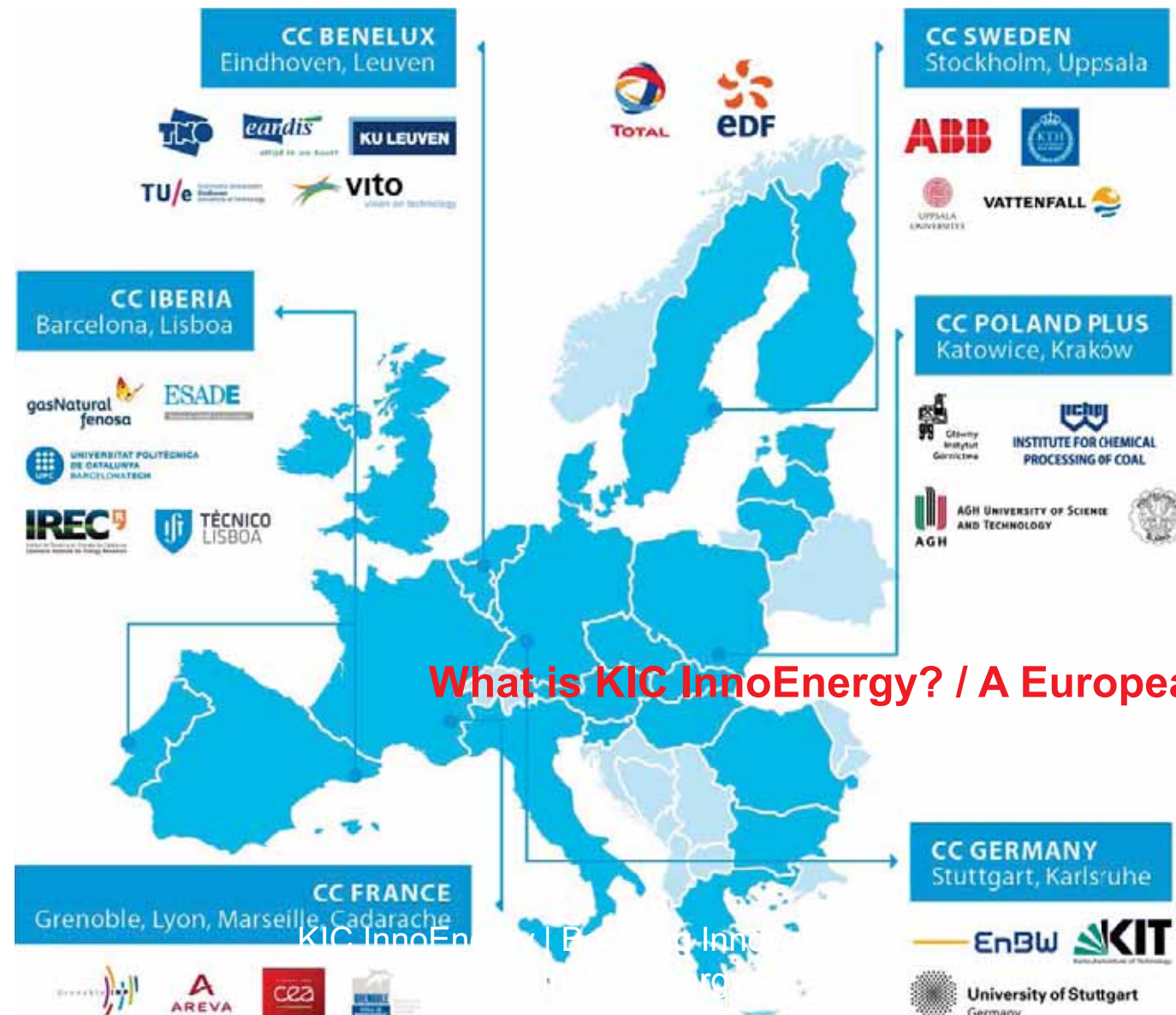
KIC InnoEnergy SE is a European company fostering the integration of education, technology, business and entrepreneurship and strengthening the culture of innovation. The strategic objective is to become the leading engine of innovation in the field of sustainable energy.

It has been designated as a one of the first three Knowledge and Innovation Communities by the EIT's Governing Board on 16 December 2009 in Budapest. KIC InnoEnergy addresses sustainable energy as its priority area.

KIC InnoEnergy is a world class alliance of top European players with a proven track record. The Consortium consists of 30+ shareholders and additional 50+ partners - companies, research institutes, universities and business schools covering the whole energy mix. They are organised around six regional units, the Co-Location Centres (CC): France, Benelux, Germany, Iberia, Poland Plus and Sweden.

What is KIC InnoEnergy? / A European Company

EMINE



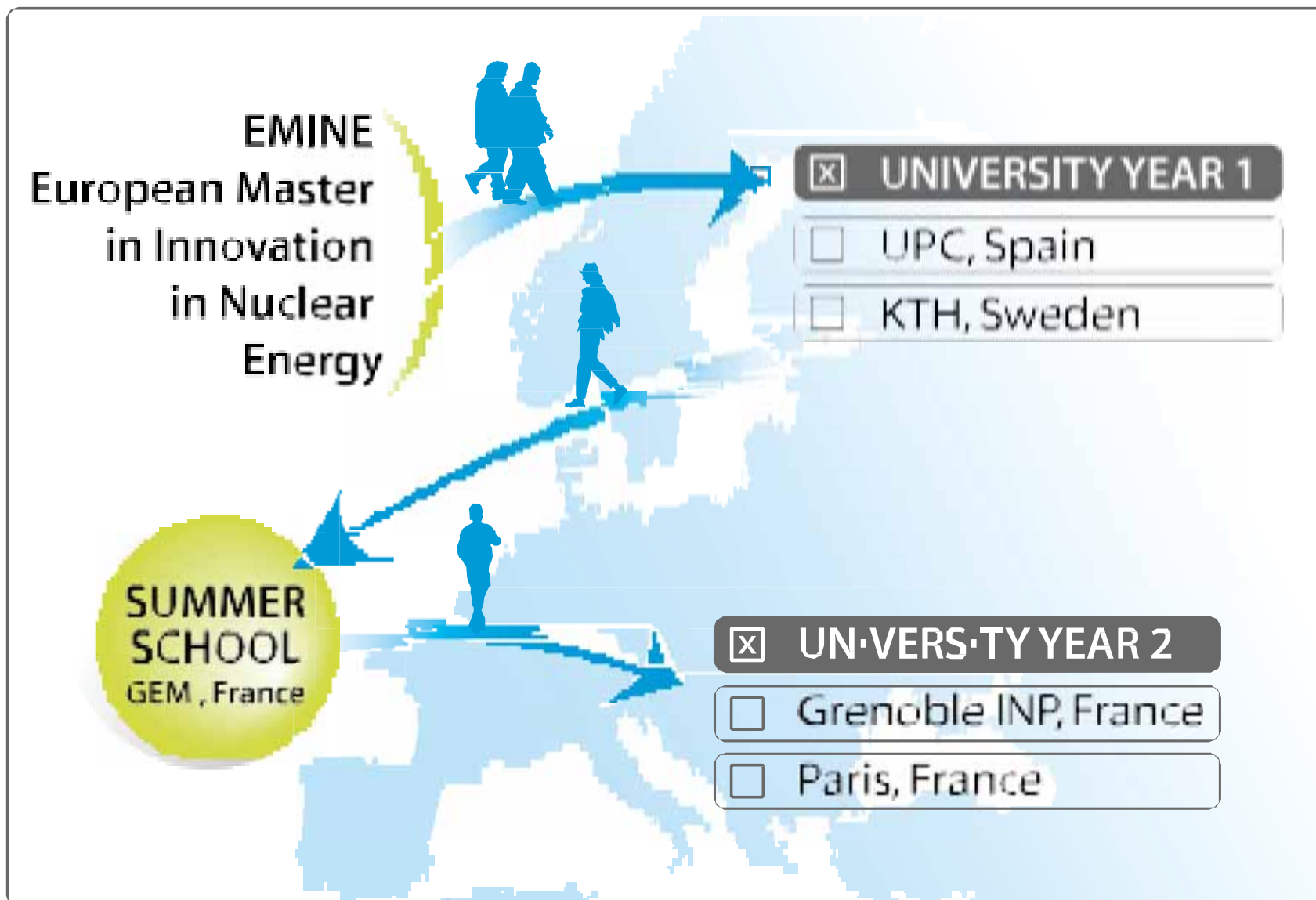
What is KIC InnoEnergy? / A European Company

European Master in Nuclear Energy (EMINE)

EMINE

- In the frame work of the European Institute of Innovation and Technology –KIC InnoEnergy.
- **Duration:** 120 ECTS, two years.
- **Language:** English
- **Face to face education.**





European Master in Nuclear Energy (EMINE)

EMINE

- **Mobility track:**
 - First year: at UPC (Barcelona, Spain) or KTH (Stockholm, Sweden)
 - Summer School: Grenoble Ecole management. France
 - Second year: at Grenoble INP (Grenoble, France) or Paris (France)
- **Participation cost:**
 - 4000 euros/year european
 - 8000 euros/year non-european



European Master in Nuclear Energy

- **30 Scholarships:**
- For European:
 - 750 Euro/month, during 2 years= 18000 euros.
 - Tuition fees:
 - 8000 euros for two years.

Total= 26000 euros

- For Non European:
 - 750 Euro/month, during 2 years= 18000 euros.
 - Tuition fees: 16000 euros for two years
 - Travel expenses: up to 1000 euros.

Total= 35.000 euros

European Master in Nuclear Energy (EMINE)

Partners:

•**Academic partners:** Grenoble INP, UPC-Barcelona-Tech, Paristech, KTH, CEA-INSTN

•**Industrial partners:** EDF, ENDESA, CEA, AREVA, Vattenfall, KIT



There is a strong participation of the industry: **EMINE**

- Industry is in the board of the EMINE.
- Industry participate in the admission process and in the distribution of Scholarships.
- Industry made comments about which courses have to be done and which not, because are more interesting for nuclear power plants, and more practical oriented.
- Industry facilitate the use of full scope simulators for experiences with students.
- Industry facilitate the internships.
- Industry supply experts in the master for lectures, in Barcelona is about 50% of the lectures. With this participation the master is more practical oriented.
- Industry facilitate the development of technical visits: Nuclear Power plants, Nuclear Fuel factory (ENUSA), Nuclear Equipment's factory (ENSA) , Underground laboratory for High level radioactive waste. ...
- Industry put money for the development of the master.



There is a strong participation of the industry:



Programme content

EMINE

- The two-year (120 ECTS) MSc EMINE programme teaches students about energy management issues and gives them in-depth knowledge of the nuclear industry. The first year is spent learning the fundamentals of nuclear engineering plus safety and radiation protection as well as the design and management of power plants, all mandatory for any nuclear engineer, at either of the following locations:
 - Royal Institute of Technology (KTH), Stockholm, Sweden
 - Technical University of Catalonia (UPC), Barcelona, Spain
- MSc EMINE also includes mandatory international mobility among recognized universities in Europe. A second year is spent at either of the following:
 - Grenoble Institute of Technology (Grenoble INP), France
 - Paris, France



First year:



EMINE

Spain

		Course name	Course code	ECTS	Course Type
UPC, Barcelona	1	Fundamentals of nuclear engineering and radiation protection	240NU011	8	Mandatory
UPC, Barcelona	1	Systems, components and materials	240NU012	6	Mandatory
UPC, Barcelona	1	Reactor Physics and Thermal Hydraulics	240NU013	7.5	Mandatory
UPC, Barcelona	1	Fuel Cycle and Environmental Impact (FCEI)	240NU014	5.5	Mandatory
UPC, Barcelona	1	Course Project 1	240NU015	3	Mandatory
UPC, Barcelona	1	Regulations and Safety	240NU021	5	Mandatory
UPC, Barcelona	1	Management of nuclear power plants	240NU022	8.5	Mandatory
UPC, Barcelona	1	Course Project 2	240NU023	3	Mandatory
UPC, Barcelona	1	Fusion technology	240NU211	4.5	Elective
UPC, Barcelona	1	Non destructive testing methods	240NU212	4.5	Elective
UPC, Barcelona	1	Core Design	240NU213	4.5	Elective
UPC, Barcelona	1	Seminars	240NU214	4.5	Elective
UPC, Barcelona	1	Monte-Carlo methods for radiation transport calculation	240NU215	4.5	Elective
UPC, Barcelona	1	Nuclear Instrumentation	240NU216	4.5	Elective

First year:



EMINE

Sweden

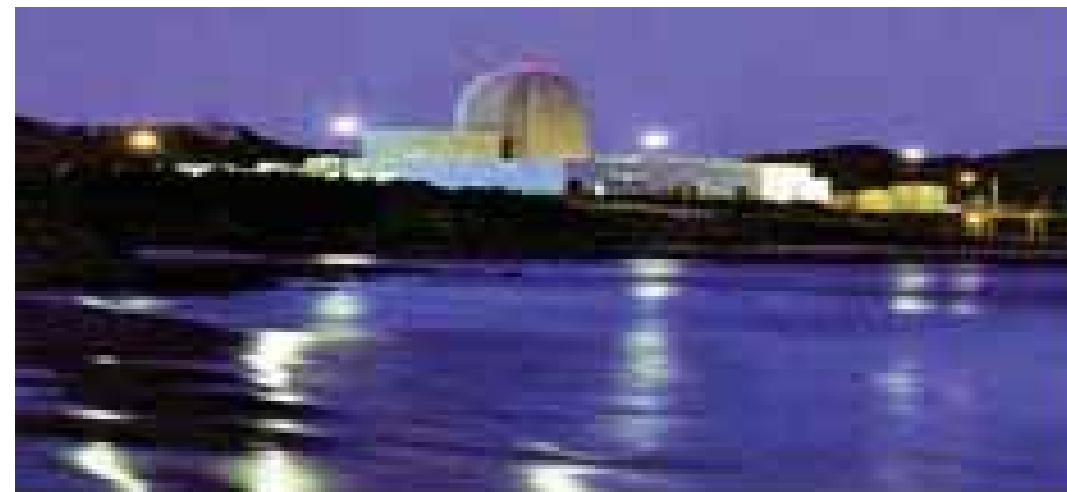
		Course name	Course code	ECTS	Course Type
KTH, Stockholm	1	Radiation, Protection, Dosimetry and Detectors	SH2603	6	Mandatory
KTH, Stockholm	1	Sustainable Power Generation	MJ2405	9	Mandatory
KTH, Stockholm	1	Nuclear Reactor Physics, Major Course	SH2600	9	Mandatory
KTH, Stockholm	1	Nuclear Reactor Technology Nuclear power Safety	SH2702	8	Mandatory
KTH, Stockholm	1	Renewable Energy Technology	MJ2411	6	Elective
KTH, Stockholm	1	Thermal-Hydraulics in Nuclear Energy Engineering	SH2701	6	Elective
KTH, Stockholm	1	Nuclear Physics	SH2302	8	Elective
KTH, Stockholm	1	Radiation Damage in Materials	SH2605	6	Elective
KTH, Stockholm	1	Generation IV Reactors	SH2604	6	Elective
KTH, Stockholm	1	Nuclear Reactor Dynamics and Stability	SH2703	6	Elective

Summer School:

- At the end of the first year, students from both UPC-Barcelona-Tech and KTH gather at a summer school at Grenoble Ecole de Management (Grenoble, France) to discuss and dissect innovation issues in energy markets in general and nuclear in particular.

Programme content second year

- Grenoble INP offers specialization in Materials Science for Nuclear Energy with two options: Fuel or Components.
- At Paris, five options are available:
 - Nuclear Reactor Physics and Engineering
 - Nuclear Plant Design
 - Operations
 - Fuel Cycle
 - Decommissioning and Waste Management





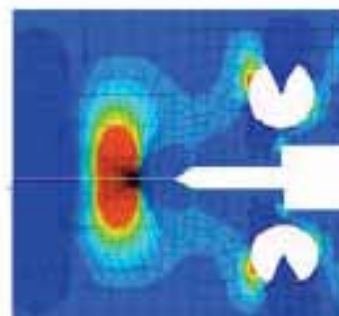
Option “Structural components”

EMINE

OPERATION FEEDBACK IN PWR

Nuclear fuel, assembly and control rod
Pressure Vessels and Internals
Circuits and Exchangers
Polymers and Concrete (nuclear containment)
Fuel Behavior under irradiation
Non Destructive Testing of components

(Waste and Downstream Management
Materials and Forthcoming generations)



ÉCOLE NATIONALE SUPÉRIEURE
DE PHYSIQUE, ÉLECTRONIQUE, MATÉRIAUX



Option “Nuclear Fuels”

EMINE

FUELS IN PWR AND OTHERS REACTORS CONCEPTS

Fabrication and characterisation of nuclear

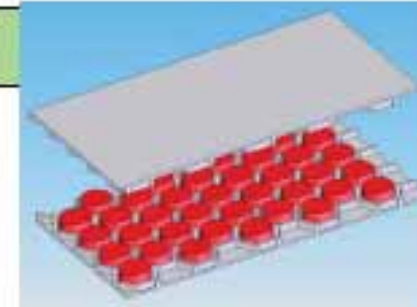
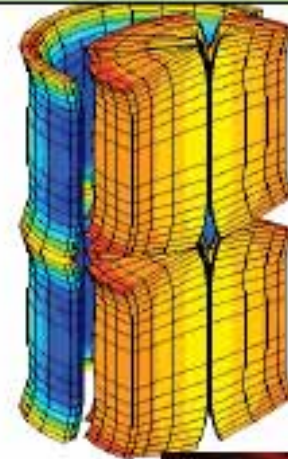
Conception of nuclear fuels and fuel assembly

Fuel Behaviour under irradiation

Fuel cycle

Laboratory classes at the CEA

MODELLING



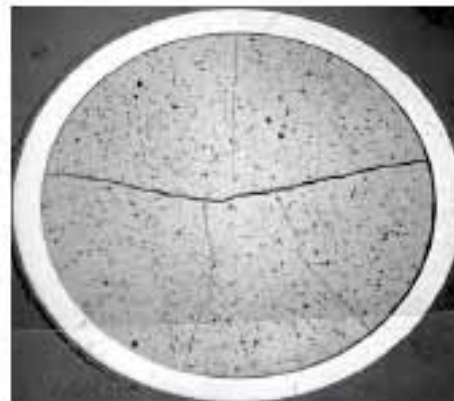
Conception

Materials, mechanics,
microstructure,



Fabrication

Process
Characterisation



Fuels in the reactor core



EMINE year2 at Grenoble INP



- **EDF** : Operational Feedback on nuclear components
 - 2 weeks by EDF R&D – 75h – 6ECTS (1 week in Grenoble + 1 week at EDF R&D)
 - Courses : seminars / utilization of industrial codes on real case studies
 - Assessment : oral presentation in front of EDF engineers



□ Materials Ageing Institute

EMINE year2 at Grenoble INP

- **CEA** : specialised courses on **nuclear fuels**
 - 2.5 weeks at CEA Cadarache - ~ 75h – 6ECTS
 - Lectures, practicals on unique installations, visits " Hot lab", RJH and ITER
 - Assessment : oral presentation in front of EDF engineers



M2 Nuclear Reactor Physics and Engineering

The objective of this major is to provide in-depth training in the field of nuclear reactor physics for the purpose of using existing tools, developing and installing third-generation reactors, and designing and developing the future systems still known as “integrated systems” (4th generation).



Courses	ECTS
Nuclear materials	5
Calculation codes for reactors	5
Thermo hydraulics	5
Neutronics	4
PWR-EPR and Gen IV reactors	4
Fuel cycle, safety, criticality, radiation protection	4

M2 Nuclear Plant Design

The objective of the *Nuclear Plant Design* major is to give students a profound education in the field of design and construction of nuclear installations, particularly with regards to safety monitoring, general operation, structures and infrastructures as well as systems and equipment.



Courses	ECTS
Materials for nuclear plants	5
Calculations codes for nuclear plant	4
Thermo hydraulics	5
Design and construction of structures and infrastructures	4
Safety and design: General architecture, system and equipment	4



The goal of this major in *Operation* is to learn how to direct and maintain a nuclear facility, in particular an electro-nuclear power station. It gives a solid knowledge of the physical phenomena which could affect the safe operation of a facility.

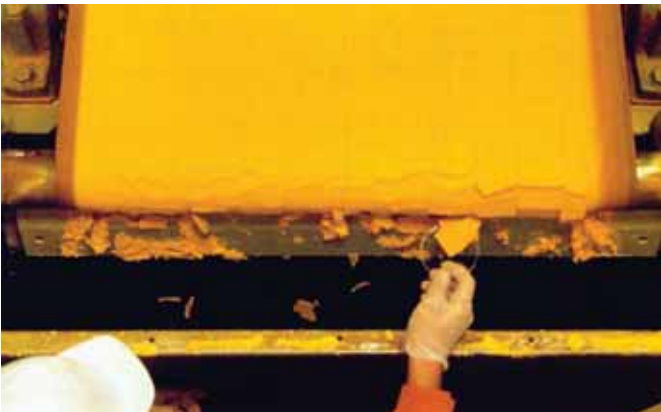
Courses	ECTS
Facility control	5
Instrumentation and calculation codes	4
Thermo hydraulics	5
Safety and production	4
Maintenance	4



The objective of the “Fuel Cycle” major is to teach the chemistry needed for the various stages of the cycle.. The vision of the “Fuel Cycle” integrates the confinement of radionuclide prior to storage, the development of new materials and the understanding of chemical mechanisms and geochemistry, which govern the evolution of storage. “Fuel Cycle” major has a proactive approach, where R&D, teaching, development and industrial engineering are intimately intertwined.

Radiochemistry	ECTS
Actinide electronic structure and speciation	4
Measurement strategy and methods	3
Physical-chemistry of nuclear materials Thermodynamics	6
Physical-chemistry in reactor	3
Traces and ultra-traces analysis	3
Radio nuclides: migration in the geosphere behavior in biosphere	6

Engineering	ECTS
Containment of waste	4
Modeling and calculation codes	4
Fuel: from the mine to the reactor	5
Storage	4
Separation and recycle	5



M2 Decommissioning & Waste Management

This course gives the necessary knowledge for the decommissioning of old nuclear power stations and management of waste. It covers all measures needed to ensure the safety of people and the environment.

Courses	ECTS
Politics, strategy and management of decommissioning	5
Instrumentation and calculation codes	4
Methods of decommissioning	4
Waste management	4
Decontamination and environment	5



Programme content

- During their second specialization year, students have the opportunity to gain a closer insight into innovation issues through a live case study where they apply a methodological ‘learning-by-doing’ approach in projects coached by KIC InnoEnergy. **During their second year, students perform a master thesis at an industrial group or research laboratory.**
- Furthermore, the involvement of leading actors from the European nuclear industry helps EMINE’s students benefit from professional conferences and lectures as well as in-house training at key research centres.

UPC Barcelona Spain

Reactor physics, thermohydraulics, safety and radioprotection



KTH Stockholm Sweden

Reactor physics, thermohydraulics, safety and radioprotection

EMINE

Summer Programme – Energy management GEM – 2 weeks

Masteriales – 1 week – CC France and Grenoble INP

Master Nuclear Energy* in Paris Several majors :

- Nuclear Reactor Physics and Engineering
- Decommissioning and Waste management,
- Fuel cycle
- Nuclear Plant Design,
- Operation

* INSTN, Centrale Paris, Supélec, Paris Sud, ParisTech

PIMS : Innovation Missions

with real startup

GEM – CCFrance

MaNuEn (Grenoble-INP)

Materials Science for Nuclear Energy

- Structural components EDF
- Nuclear Fuels CEA

INDUSTRIAL INTERNSHIP (5 months)



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH



ParisTech



endesa



VATTENFALL



A lot off practical activities and technical visits are developed

EMINE





EMINE

Accreditation

On completion of the EMINE programme, a Master of Science degree will be awarded from the universities where studies were performed during year one and year two, i.e. a double-degree. A diploma from KIC InnoEnergy related to innovation and entrepreneurship will also be presented.

European Master in Nuclear Energy (EMINE)

- **Students from:**

Argentina, Bangladesh,
Belgium, China, Egypt,
Ethiopia, France, Germany,
India, Indonesia, Italy,
Lebanon, Mauritius,
Montenegro, Norway,
Poland, Spain , Sweden,
Turkey, United Kingdom, USA.



Face to Face education.

EMINE



Äspö Hard Rock Laboratory

EMINE



Äspö Hard Rock Laboratory 480 m deep

END

<http://www.kic-innoenergy.com/emine/home/>