



FIRST FREDMANS TRAINING SESSION ON NUCLEAR FUEL FABRICATION AND CHARACTERISATION

Venue: Institute for Nuclear Research, Pitesti – Mioveni, Romania

25 – 29 September 2023

Programme

September 25, 2023

Day 1: Fuel characteristics and performances requested for an LFR reactor (10:00 – 17:00)

(1h) 10:00 – 11:00	Nuclear fuels for existing and future reactors	Daniela Diaconu (RATEN)
(1h) 11:00 – 12:00	Introduction to the desired characteristics of a fuel for an LFR Overview of most commonly employed fuel forms for FRs	Francesco Lodi (ENEA)
0.5h	Coffee break	
(1h) 12:30 – 13:30	MOX fuels: Introduction Fuel performance in-core (mentions vs. LWR)	Francesco Lodi (ENEA)
13:30 -14:30	Lunch	
(1h) 14:30 -15:30	MOX doped with MA: New challenges relative to standard MOX	Simone Gianfelici (ENEA)
0.25h	Coffee break	
15:45 -17:00	Interactive exercise: Designing a FR fuel pellet encompassing MOX and Nitrides form	Francesco Lodi (ENEA)

September 26, 2023

Day 2: Nuclear fuel fabrication (9:00 - 17:00)

(1h) 9:00 – 10:00	Nitride fuels: - Introduction - Fuel performance in-core (mentions vs. MOX)	Janne Wallenius (LeadCold)
0.5h	Coffee break	
10:30 -12:00	Nuclear Reactors & Fuel Fabrication - Types of Nuclear Reactor & Fuel o Techniques used for fuels including UN, UC and MOX o Chemical processes involved o Advantages and drawbacks Individual and team exercises	Daniel Shepherd (NNL)
12:00 -13:00	Lunch	
(1h) 13:00 – 14:00	Oxides fuel fabrication - Fabrication flux Chemical processes in UO ₂ powder fabrication	Iulia Dumitrescu (RATEN)
1 h 14:00 -15:00	Oxides fuel fabrication (cont) - Physical processes in UO ₂ pressing and sintering	Daniela Diaconu (RATEN)
0.5h	Coffee break	
(1h) 15:30 -16:30	Irradiation effects in nuclear fuel Nondestructive characterization of irradiated fuel	Ovidiu Ichim (RATEN)
16:30 -17:00	Q&A	All

September 27, 2023
Day 3: Nuclear fuel characterisation (9:00 – 17:00)

(1.0h) 9:00 – 9:45	Advanced fuel manufacturing techniques	Manuel Pouchon (PSI)
(1.0h) 9:45 – 10:45	Fresh nuclear fuel characteristics <ul style="list-style-type: none"> - Powder characteristics: <ul style="list-style-type: none"> o density, porosity and pore distribution; o granulometry; isotope composition, impurities, stoichiometry - Sinterability test - Sintered pellet characteristics (density, porosity, grain size, microstructure, ...) 	Daniela Diaconu Iulia Dumitrescu Mariana Postelnicu Livia Stoica (RATEN)
15 min	Coffee break	
(1.0h) 11:00 – 12:00	Irradiated fuel characterisation <ul style="list-style-type: none"> - Fission gas pressure and isotopic composition; - Fission products distribution - Burn-up - Microstructure 	Marin Mincu Madalin Savu (RATEN)
1h	Lunch	
(2.0h) 13:00 – 15:00	Scientific visit: Fuel Fabrication Plant (FCN)	
(2.0h) 15:00 – 17:00	Scientific visit: TRIGA reactor and Hot Cells Facility	

September 28, 2023
Day 4: Hands on training on fuel fabrication and characterisation (9:30 – 17:00)

0.5h 9:30 – 10:00	Radioprotection aspects in nuclear fuel fabrication	Cristian Dulama (RATEN)
(1.0h) 10:00 – 11:00	Equipment used in fuel fabrication	Visit of fuel manufacturing laboratory
0.5 h	Coffee break	
(1.0h) 11:30 – 12:30	Hands on training on characterisation techniques (1st part) <ul style="list-style-type: none"> - Pellets density determination - Grain size determination (sample preparation and metalographic investigation); - Microstructure analysis (SEM); 	Mariana Postelnicu Iulia Dumitrescu Livia Stoica (RATEN)
1h	Lunch	
(2.5 h) 13:30 – 16:00	Hands on training on characterisation techniques (2nd part) <ul style="list-style-type: none"> - Practical applications 	
16:00 – 17:00	Results presentation and discussion	

September 29, 2023
Day 5: Verification

9:00 – 13:00

(1.5h)	Q&A and final discussions
(1.5h)	Verification
(0.5h)	Coffee break
(0.5h)	Awarding of diplomas

Lecturers:

Dr. Francesco Lodi, ENEA, Italy
Dr. Janne Wallenius, LeadCold, Sweden
Dr. Simone Gianfelici, ENEA, Italy
Dr. Daniel Shepherd, NNL, UK
Dr. Manuel Pouchon, PSI Suisse
Dr. Daniela Diaconu, RATEN, Romania
Dr. Iulia Dumitrescu, RATEN, Romania
Dr. Marin Mincu, RATEN, Romania
Dr. Ovidiu Ichim, RATEN Romania
Madalin Savu, RATEN Romania
Dr. Cristian Dulamă, RATEN, Romania
Dr. Livia Stoica, RATEN, Romania
Mariana Postelnicu, RATEN, Romania