UCLouvain

lbnen2010

2023

Nuclear fuel cycle (Centre d'étude nucléaire-Mol)

3.00 credits		Q1

Language :	English
Place of the course	Autre site
Prerequisites	The following BNEN courses are a prerequisite • Nuclear Energy: Introduction • Introduction to Nuclear Physics and Measurements Basic chemistry, material sciences, nuclear physics
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 The objective is to provide students an overall view of the fuel cycle, from cradle to grave: • The front-end of the fuel cycle: ore extraction, conversion and enrichment, fuel fabrication and use in the power plant, spent fuel reprocessing and recycling of re-enriched reprocessed U and Pu as MOX in PWR. • The back-end of the fuel cycle: the radioactive waste management, ranging from waste characteristics, waste treatment technologies, disposal technologies, safety assessment of geologic disposal.
Evaluation methods	Oral examination; written preparation
Content	**First part -The front-end of the fuel cycle (H Druenne)** • Uranium extraction and treatment of ores; worldwide resources ;Conversion of concentrated ores ; • U enrichment: Basic principles of isotopic separation. Theory of the cascade (symmetrical cascade) and description of the main techniques; • Fabrication process and description of the various current commercial fuel types; • Basics of the in-core fuel management; • Isotopic evolution under irradiation regarding residual heat and source term; • Reprocessing of UO2 fuel elements: description of the PUREX process ; • Recycling of U and Pu: technology and industrial limits, equivalence principle and MOX neutronic design; • Interim storage : description of the main concepts for dry and wet storage. **Second part -The back-end of the fuel cycle (P. Van Iseghem)** • Categories, inventory of radioactive waste • Conditioning and immobilisation of radioactive waste • Characterization of radioactive waste (general; scaling factors; destructive analysis; non-destructive analysis) • Assessment of the safety of geological disposal (methodology; some typical results from the safety assessment) • Impact of new fuel cycles on radioactive waste disposal • Geological repositories: key criteria for designing a disposal concept, overview of ongoing international programmes, and discussion of the Belgian supercontainer concept. • Technical visits to the Belgoprocess facility and to the ESV underground research laboratory in clay on the SCK-CEN site
Inline resources	https://www.sckcen.be/fbnen
Other infos	This course is part of the Advanced Master programme in nuclear engineering organized by the Belgian Nuclear Higher Education Network (BNEN). BNEN is organised through a consortium of six Belgian universities and the Belgian Nuclear Research Centre, SCK-CEN and takes place at the SCK-CEN in Mol. **Prof. Pierre Van Iseghem** -Université de Liège **Prof. Hubert Druenne**- Université de Liège
Faculty or entity in charge	EPL

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Advanced Master in Nuclear Engineering	GNUC2MC	3		