UCLouvain

lbnen2003

2023

Safety of Nuclear Powerplants (Centre d'étude nucléaire-Mol)

5.00 credits		Q2

Language :	English
Place of the course	Autre site
Prerequisites	Courses in the following field · Nuclear reactor theory · Nuclear thermal hydraulics
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 To introduce the students to methods and practices supporting the defense-in-depth approach for nuclear power plants. More specifically: • To present elements of nuclear safety philosophy. • To understand how to insure the link between nuclear safety and reactor operation. • To master all the contributors to the core reactivity balance and power distribution in normal operation. • To understand specific measurement and control issues in nuclear reactors. • To introduce the basic notions and techniques of system reliability engineering. • To understand the concepts of safety analyses (both deterministic and probabilistic), and the fundamentals of probabilistic safety analysis (PSA). • To present some PSA-based applications.
Evaluation methods	Operation & Control First and second session: Individual oral exam, closed book, written preparation Reliability & Safety First and second session: An oral examination (closed book) with one question on the concepts and one exercise
Content	Operation & Control (28h) • Cycle specific safety evaluation methodology. • Basic principles of the in-core fuel management based on the linear reactivity model. • Reactivity coefficients (moderator, Doppler), neutron poisons (xenon, samarium, '), their variation with burnup and core state parameters and their impact on core power distribution • Reactivity control means (boron, control rods, burnable poisons) and their sensitivity to the core burnup and in-core fuel management parameters. • Operating modes, operating limits and protection diagram. • Fuel rod design and thermal-mechanical behavior in normal operation and accidental conditions. • Thermal design procedures and elaboration of the core thermal limits and core protections. • Core control, surveillance and protection systems **Optional** visits and laboratory session: • Visit of a Nuclear Power Plant. • Two day session of compact and full scope Nuclear Power Plant simulator. Seminars: Overview of design basis accidents and severe accidents; Discussion of selected past nuclear (severe) accidents (TMI, Chernobyl, Fukushima-Daiichi...) Reliability & Safety (14h theory + 6h exercises) • Introduction to nuclear safety and defence in depth • concept of risk, individual and societal risk criteria, release limits, core damage frequency limit, safety goals at function or system level • deterministic vs. probabilistic safety analyses; • probabilistic safety assessment (PSA) methodology and PSA levels • Component reliability • Fault tree and event tree analysis • Markov analysis • Common cause failure analysis • Elements of human reliability analysis • Elements of the level 2 and level 3 PSA methodology • Limits of the classical PSA methodology

	• PSA-based applications
Inline resources	https://www.sckcen.be/fbnen
Other infos	Course location: SCK-Cen (Mol) **Prof. Greet Janssens-Maenhout** -Universiteit Gent NN - Universiteit Gent **Prof. Pierre- Etienne Labeau** -Université Libre de Bruxelles
Faculty or entity in charge	EPL

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Mechanical Engineering	MECA2M	5		
Advanced Master in Nuclear Engineering	GNUC2MC	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		
Master [120] in Energy Engineering	NRGY2M	5		