UNIVERSITÀ DI PISA

DECOMMISSIONING OF NUCLEAR PLANTS AND RADIOACTIVE WASTE MANAGEMENT

ROSA LO FRANO

Academic year	2023/24
Course	INGEGNERIA NUCLEARE
Code	1099I
Credits	6

Modules	Area	Type	Hours	Teacher(s)
DECOMMISSIONING OF NUCLEAR PLANTS AND RADIOACTIVE WASTE MANAGEMENT	ING-IND/19	LEZIONI	60	ROSA LO FRANO

Obiettivi di apprendimento

Conoscenze

The student who successfully completes the course will have the capability to:

- analyze the behaviour and the main functional, structural and safety issues of plants and systems to be decommissioned;

- demonstrate a solid and advanced knowledge on the relevant design issues of plants undegoing/to be decommissioned
- interface with/join specialists in different areas;

- understanding of common problems affecting the structures to decommission and dismantle
- understanding of dismantling techniques (supported also by FEM/system codes) and regulations/requirements

Modalità di verifica delle conoscenze

The students will be assessed on the demonstrated ability to discuss the main course contents using the appropriate terminology. During the oral examination the student must be able to demonstrate the acquired knowledge of the course material and be able to discuss and develop one or more exercises related to the main topic presented during the course. Students must demonstrate to be able to preliminary propose a coherent approach for the implementation of DECOM plan of (SSCs or a part of) plants and critically discuss the technological solution.
Methods: oral examination

Capacità

The following main skills are provided by the course:

- the capability to analyze the behaviour and the main functional, structural and safety issues of plants and systems to be decommissioned;
- capability to approach the relevant design issues of plants undegoing/to be decommissioned

- capability to interact with/join specialists in different areas;
- understanding of commong problems affecting the structures to be decommissioned and dismantled and the

Modalità di verifica delle capacità

The assessment criteria of skills consists in an oral examination that includes the assignment of typical problems

selected dismantling techniques so to safely succeed in the proposed DECOM plan

Comportamenti

The students are supposed

- to develop the capacity to analyse the after shut-down behaviour of plant/plant systems and structures to coherently prepare sustainable decommissioning plan;
- acquire a solid and advanced knowledge on the relevant issues thoroughly the decommissioning (decontamination,

dismantling, and demolition, RWs management);

- be able to critically analyse decontamination/dismantling/ demolition techniques according to site aspects;
- achieve those attitudes typical of design safety design culture; i.e. accountability, open and communicating attitudes, questioning attitudes
- to develop a "safety oriented" and system-based attitude, thanks to the understanding of the working principles of the

Modalità di verifica dei comportamenti

The oral interview will ascertain the personal attitudes by proposing questions and problems related to the decommissiong problem to face for components and parts of plants. During the oral examination the project assigned on the implementation of a DP for a plant component will be examined and discussed

Prerequisiti (conoscenze iniziali)

- Basic knowledge about nuclear plants, nuclear measurements, radioprotection, materials
- Mechanical technology, science and construction technique, Quality Assurance, and safety
- Ability to interpret overall drawings and details.

Indicazioni metodologiche

The course is high interdisciplinary because of the topics and problems treated in the lectures, such as e.g. regulatory aspects, safety aspects and site characterisation, environmental impact assessment, financial aspects, management, etc.
The course consists of lectures, with visual aids such as .ppt/videos, case study analysis and applications integrated in the classroom together and correlated with theoretical notions presented.
The teaching activity, in relation to the level of preparation reached by the students, can be completed by the autonomous development, under the guidance of the teacher, of a simple project in which decommissioning activities and concepts will be applied.
The course can also be integrated with lectures and seminars of external teachers and experts.
The subdivision of the total working hours foreseen offers the student the possibility to verify and improve his own learning ability also through a synergic interaction between the student and the teacher (e.g. meetings, email or other methods of communication)
The attendance to lecture is advised.

Programma (contenuti dell'insegnamento)

Introduction to the decommissioning and radioactive waste management: overview of current status of plant under decommissioning. Activities relevant to decommissioning. Oversight to ensure safety waste Directive: National and European policy
Financial Resources: Waste Directive & EU recommendation strategies. General provisions and decommissioning strategies options
Decommissioning: considerations at the design and construction phase review of design features and specific factors influencing Decommissioning & RW Management. Consideration about the functional, structural and safety aspects affecting the decommissioning planning before/after the facility shut down. Planning and safety assessment for RWs decommissioning. Paper Flow and Authorization Decommissioning Planning (DP): phases and elements of planning. Graded approach to DECOM management
Management during Decommissioning: system for managing wastes from decommissioning or environmental remediation. Quality assurance and documentation. Significance of safety assessment and radiological characterization.
Plant decommissioning: facility constraints, siting and operation/life-cycle issues. Time period for the decommissioning activities and process (e.g. NPP DECOM phases). Integrated safety management decommissioning requirements: from the optimization of protection and safety to the responsibilities of the regulatory body and of the licensee
Decommissioning Requirements: Graded Approach to Safety Assessment. Safety Assessment methodology: overview, objectives and principles. IAEA Requirements relating the selection of a DECOM strategy, step for planning the DECOM and hoe to prepare a final decommissioning plan
Hazard analysis: identification and screening of the radiological and non-radiological hazards. Approaches to hazard identification and preliminary assessment: example list of hazards and risks associated with typical decom activities (Ref. IAEA) modelling and calculation of consequences
Radiological characterisation: radionuclide inventory and RWs classification. General objectives of the radiological characterization and efforts during all decommissioning planning stages (pre-operational, operation, transition phase, dismantling and release)
Key Activities in a Radiological Characterisation Campaign Methodology and development of the categorization system: contamination and activation processes. Radiological characterisation: methods and techniques for the characterization and measurement
Dismantling and decontamination techniques used in decommissioning: current main techniques, criteria and issues for decontamination: before/after dismantling; fixed and smearable contamination; metal, concrete, site or soil decontamination. Factors affecting the decontamination technology. Chemical decontamination (i.e. MEDOC® process), Electrochemical decontamination, Different electrochemical decontamination methods (i.e. PHADEC, ELDECON etc.). Treatment of the spent decontaminating reagents. Physical decontamination process.
Demolition and dismantling: techniques, advantages and drawbacks
RWs Management: Material destination and storage of RWM
Storage and Transportation (interim or long term) of radioactive material/waste: packaging system options.
Disposal Facility Characterization: Pre-disposal management. Long-term containment and isolation Disposal Practices. Surface Repository. Near-Surface Repository. Geological disposal
Identification and analysis of Decommissioning Costs
Immobilization of RWs: technique used for the solidification of radioactive waste, such as the cementation, bituminization, geo-polymerization, calcination etc.

Bibliografia e materiale didattico

- Decommissioning and radioactive waste management, A. Rahman
- Radioactive waste management, J.H. Saling and A. W. Fentiman
- National and Int. Regulations for the sectors of interest, generally available at the Library of the School of Engineering
- Teaching materials distributed during the course
- Further bibliography indicated during lessons

Indicazioni per non frequentanti

The teaching material, updated year by year by the teacher, will be provided to students by email or making it available on a shared folder
The receipt of the students is always available to support students in solving any possible encountered learning problem

Modalità d'esame

The assessment method, as described above, consists in an oral examination that includes assignment of typical problems related to the theory and the decommissioning methods and techniques used for components and/or part of plants..

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