



50 25418 NUCLEAR POWER PLANTS

Q10

Department:	721 Nuclear Physics & Engineering	
Coordinator:	Carlos Tapia	Pav. C, Planta 0
Type	Credits Theory / Problems / Laboratory:	3 / 3 / -
OPTATIVE	European Credits ECTS	5 Language: Spanish

OBJECTIVES

Main objective

Within the electrical energy production system framework, the main objective will be to provide to the student the technical and security criteria that are applied to the projects, the operation and the nuclear power plants dismantling. There will be also shown the main aspects of the technology components, systems and structures of the power plants and the management of their operation.

Specific objectives

To present the involved areas of engineering in the nuclear power plants project, construction and operation.

To emphasize the importance of the administrative and technical verification security methods in complex power facilities.

To emphasize the concept of security culture and the human factor in the power plants operation.

CONTENTS

1. Classification of the nuclear power plants. (2 hours)

Types, operative experience and power facilities in Spain and in the World. Light water power plants. Heavy water power plants. Graphite-gas power plants. Advanced design power plants. Other power stations

2. Power plants design criteria (3 hours)

Risk concept. Probabilistic Risk Assessment (ARS). Design Basic Accidents (ABS). Main systems reliability and availability. Security Criteria in the site, project and operation of the nuclear power plants. Norms and Codes. Security studies. Defense-in-Depth. Criteria on redundancy and physical separation. The passive security.

3. Nuclear Reactors. (2 hours)

Thermal power generation in the reactor. Nuclear and Residual power. Core power distribution. Stability. Reactors transfer heat rate. Residual power of radioactive products.

4. Reactors Technology. (3 hours)

Reactors materials and internal components. Nuclear steam supply system. Nuclear and Thermal limits. Radiation effects in the nuclear components.

5. Energy conversion systems. (3 hours)

Thermodynamic cycles. Main components of the conversion system: Steam turbines and condensers. Feed water system. Cooling systems in opened, closed or mixed cycle.

6. Operation principles and the reactors and power plant control system. (2 hours)

Operation states. Reactivity control systems. Reactors nuclear instrumentation. Protection systems. Data processing.

7. Thermal hydraulic analysis in nuclear systems. (4 hours)

Core heat transport. Coolant transient. Loss of Coolant Accident. TMI2 accident.

8. Electric production system. (2 hours)

Nuclear power station. Electrical system. One-line diagram. Emergency electrical system. Electrical consumptions balance of a power plant in operation and standby.

9. Auxiliary systems and security systems. (5 hours)

Main Auxiliary systems: Service Water System. Intermediate Cooling System. Residual Heat Removal System. Main Security systems: Emergency Core Cooling System. Emergency Feed Water System. Residual Heat Removal System. The Containment and the Engineering Safeguards.

10. Buildings location in the plant. (2 hours)

Areas classification. Construction norms. Reactor building: containment and penetrations. Fuel building, auxiliary building, electrical building, turbines building, control building. Other buildings and structures.

11. Plants operation management (2 hours)

Radiological safety management. Maintenance. External Inspection. Quality assurance. Fuel cycle associated to the power plant. Fuel and reload necessities. Operating procedures. The energy costs.

Experiences (SIREP Nuclear Power Simulator Experiences)

- 1.- Experience 6. Reactors standard states. Transition from power operation to hot shutdown.
- 2.- Experience 7. Reactors standard states. Transition from hot shutdown to cold shutdown.
- 3.- Experience 8. Cluster rods calibration.
- 4.- Experience 9. Reactors auto stabilization.
- 5.- Experience 10. Electric network disconnection and house load operation.

Seminaries

- 1.- Licensing requirements in Spanish nuclear power plants (2 hours)
- 2.- Environmental impact (2 hours)
- 3.- Reactors reactivity balances (2 hours)
- 4.- Fuelling and Operating strategy (2 hours)
- 5.- Water Chemistry in Nuclear Power Plants (4 hours)
- 6.- Plants maintenance and work conditions (2 hours)
- 7.- Nuclear fuel irradiation study (2 hours)

- 8.- Operation radioactive waste production. Low and medium level waste. (RBMA) (2 hours)
- 9.- Design modifications of nuclear power plants in operation. (2 hours)
- 10.- Nuclear power plant ageing management program . (2 hours)
- 11.- Nuclear power plants decommissioning. (4 hours)

METHODOLOGY

The subject educational load is of 6 credits (3 theoretical and 3 practical). The theoretical credits correspond to the general agenda and the practical credits to the agenda of seminars and the simulation experiences (SIREP). The theoretical classes are developed in slate sessions. The description of structures, systems and components leans in audio-visual means. In the sessions of seminars, examples are considered and solved. Real projects, programs, and experiences are also analyzed. In the practical sessions, there will be used nuclear power plant simulator, type PWR, SIREP.

Each student will be able, optionally, to choose a subject of the propose list by the professor at the beginning of the course. Each subject contains a test to complete by the student and an amount of information sources. The works were developed under the professors tutorial position. The work memories, of a 10 pages minimum extension, will contain the answers to the test and an information sources evaluation. They must be delivered during the month of May and until the last school week. Each student will defend the work in a 20 minutes meeting, in a schedule agreed with the professor. The work accomplishment implies a dedication load of 15 hours for the student.

EUROPEAN MASTER OF SCIENCE IN NUCLEAR ENGINEERING (EMSNE):

The five ECTS corresponding to this subject count for the obtaining of the European Master of Science in Nuclear Engineering (EMSNE) from the European Nuclear Education Network (ENEN).

<http://www-sen.upc.es>

CALENDARIO DEL CURSO 2005-2006:

There are classes on Mondays and Wednesdays from 12h to 14h PM, from September 12 to December 22 of the 2005.

