240NU021 - Regulations and Safety

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2017
Degree: MASTER'S DEGREE IN NUCLEAR ENGINEERING (Syllabus 2012). (Teaching unit Compulsory)
ECTS credits: 5

Teaching languages: English

Coordinator: FRANCESC-JOSEP REVENTOS PUIGJANER

Degree competences to which the subject contributes

Specific:
2. Ability to assess the environmental impact of a nuclear facility, both in operation and in the rest of the life cycle.
3. Ability to correctly apply the rules of safety and conduct analysis of nuclear plant safety.
4. Ability to use effectively, understand the operation and validity ranges, and interpret the results of thermal-hydraulic codes and fluid dynamic calculation.
5. Ability to write the main systems of a nuclear power plant and identify the main features of such systems.
6. Knowledge of techniques and procedures for the management of radioactive waste.
7. Owning a theoretical and practical basis of reactor physics and thermal hydraulics that allow you to easily navigate issues related to plant operation and safety.

Transversal:
1. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
8. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
9. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
10. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Teaching methodology

The course on Regulations and Safety is mainly based on theory sessions, complemented with autonomous learning (calculation and documentation subjects) and cooperative learning (other subjects)

Learning objectives of the subject

The student will be able to:
- Describe the structure Spanish regulations related to nuclear safety and radiation protection.
- Identify and manage radiation protection regulations applicable to operation and management of radioactive waste.
- Analyse the relation between the Spanish nuclear legislation and international references.
- Distinguish the different types of official documents related to the operation of nuclear and radioactive facilities.
- Use the concept of safety function.
- Explain and describe the philosophy of defense in depth.
- Sort actual accidents and incidents.
- Correlate design criteria of safety systems with the description and function.
- Correlate the functions of components with its classification.
- Use operating technical specifications regarding their safety content.
- Follow an emergency operation procedure.
- Perform a calculation simulating a sequence of emergency operation and write the corresponding report.
- Describe the guidelines in case of severe accident.
- Use the concept design basis accident.
- Analyse the licensing regulations and its philosophy.
- Distinguish deterministic and probabilistic safety analysis.
- Analyse the results of calculations using conservative methods.
- Apply BEPU methodologies to licensing thermalhydraulic calculations and write the corresponding report.
- Use the fundamental concepts of Probabilistic Safety Assessment.
- Analyse the siting issue of nuclear plants following geological, environmental and social considerations.
- Analyse the safety parameters of nuclear fuel transport.
- Analyse the safety parameters of nuclear fuel pools.
- Identify the impact of safety culture in technical management tasks.
- Interpret the treatment of operating experience conducted by international agencies.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 30h</th>
<th>24.00%</th>
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</thead>
<tbody>
<tr>
<td>Hours small group:</td>
<td>15h</td>
<td>12.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>80h</td>
<td>64.00%</td>
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</table>
## 1. Introduction and regulatory structure

**Learning time:** 13h  
**Theory classes:** 8h  
**Self study:** 5h

**Description:**  
The course starts with an overview that includes: Safety objectives, Structure of the subject and General notions. Safety concepts like Safety functions, Defence in depth and available approaches are introduced. Finally, Regulatory structure including Nuclear Energy regulation basics and International Organizations are also part of this block.

**Related activities:**  
Independent learning, reading of related material

**Specific objectives:**  
CE15 and CE16

## 2. Actual accidental events

**Learning time:** 10h  
**Theory classes:** 6h  
**Self study:** 4h

**Description:**  
Involved concepts and categorization of actual accidents are presented along with a description and the lessons learned from the most relevant including: TMI-2 Accident, Chernobyl Accident and Fukushima

**Related activities:**  
Independent learning, reading of related material

**Specific objectives:**  
CE15 and CE16

## 3. Deterministic safety analysis

**Learning time:** 20h  
**Theory classes:** 12h  
**Self study:** 8h

**Description:**  
The block includes the fundamentals of deterministic safety analysis and consequence analysis. Accident phenomenology is also presented along with Methodologies involved (Best Estimate or Conservative)

**Related activities:**  
Independent learning, reading of related material

**Specific objectives:**  
CE15 and CE18
### 4. Probabilistic safety analysis

**Description:**
Basic Tools of Probabilistic Safety Analysis are introduced. Qualitative and numerical results are included.

**Related activities:**
Exercises on Fault Tree/Event Tree model construction from a set of simplified drawings of systems, accident description and procedures

**Specific objectives:**
CE15 and CE19

**Learning time:** 16h
- Theory classes: 10h
- Self study: 6h

### 5. Procedures and guidelines

**Description:**
Emergency Operating Procedures and Sever Accident Management Guidelines are presented

**Related activities:**
The contents of this block are linked with a simulator session devoted to Emergency Operating Procedures

**Specific objectives:**
CE15 and CE18

**Learning time:** 10h
- Theory classes: 6h
- Self study: 4h

### 6. Others

**Description:**
The facts detailed in this block are areas related to the description of the security and a final talk of "Main issues in nuclear security"

**Related activities:**
Independent learning, reading of related material

**Specific objectives:**
CE15 and CE18

**Learning time:** 7h
- Theory classes: 4h
- Self study: 3h
# Planning of activities

<table>
<thead>
<tr>
<th>Planning of activities</th>
<th>Hours: 10h</th>
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</thead>
<tbody>
<tr>
<td><strong>1. ELABORATION OF SHORT REPORTS (IN GROUPS OR INDIVIDUALLY) ABOUT DIFFERENT CONCEPTS EXPLAINED IN THE COURSE</strong></td>
<td></td>
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<tr>
<td>Description:</td>
<td>This activity aims to promote a better understanding of the topics explained in class through the comprehensive reading of related material and the elaboration of short reports about several aspects of interest.</td>
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<tr>
<td>Support materials:</td>
<td>Material delivered by the lecturer</td>
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<tr>
<td><strong>2. PERFORM A CALCULATION OF AN ACCIDENTAL SEQUENCE (INDIVIDUAL TASK USING A SYSTEM CODE)</strong></td>
<td>Hours: 44h</td>
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<td>Laboratory classes: 4h</td>
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<td>Self study: 40h</td>
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<tr>
<td>Description:</td>
<td>Perform a calculation in order to predict the expected phenomenology of a given accidental sequence using a thermal hydraulic code and a plant model. Objectives: It contributes to CE15</td>
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<tr>
<td>Support materials:</td>
<td>Material will be delivered by the lecturer that will present the subject during a kickoff and a follow-up devoted sessions</td>
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<td><strong>3. READING AND COMPREHENSION EXERCISE (INDIVIDUAL TASK)</strong></td>
<td>Hours: 10h</td>
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<td></td>
<td>Self study: 10h</td>
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<tr>
<td>Description:</td>
<td>Read a technical-scientific document (usually a revue article). The student, while answering lecturer's questions, has to demonstrate he/she has understood the contents of it.</td>
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<tr>
<td>Support materials:</td>
<td>Material will be delivered by the lecturer</td>
<td></td>
</tr>
<tr>
<td>Specific objectives:</td>
<td>It contributes to CE15</td>
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</tr>
</tbody>
</table>
Qualification system

\[ FQ = 0.5 \times CQ + 0.5 \times EQ \]

FQ: Final Qualification

CQ: Class qualification. This qualification is obtained weighting the different activities performed using the proportion of hours of each topic related to the total amount of hours of the course.

EQ: Exam qualification. At the end of the semester students will have to answer an exam to determine the achieved level of understanding.

Bibliography