<table>
<tr><th colspan="3">Course on “Basic operation of nuclear reactors” (3 ECTS)</th></tr>
<tr><th>Units and LO Statements</th><th></th><th></th></tr>
<tr><td rowspan="3">Unit 1 –Principles of a nuclear reactor (15 hours)</td><td colspan="2">Responsibility / Autonomy</td></tr>
<tr><td colspan="2">Figure out the principles of nuclear reactors (EQF=7)</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>- Reactor principle and systems
• Neutron interaction, Cross section, Fission
• Reactor principle, Reactor systems
• Examples of Research and Industrial reactors
The neutron kinetics
• Equations of kinetics
• Study of the critical state
• Sub- and Super-critical states
Thermal hydraulics.
• Water as a coolant: fluid properties
• Energy balance and fuel temperature
• Heat transfer in (research) reactors
• Pressure drops and coolant flow rate
• Thermal and hydraulic design
Basic safety
• General principles
• Safety Analysis Methods
• Performance of Safety Analysis
• Case study</td><td>• Integrate and apply theory and kinetics of nuclear reactors.
• Apply reactor thermal hydraulics.
• Approach and manage the reactor operation.
• Explain physics underlying the reactor operation.
• Assess safety principles and background</td><td>• Basic nuclear interaction in a reactor core
• Main core elements
• Reason for moderating neutrons
• Reason for core stability
• Reactivity variation and management
• Core thermal hydraulics and heat transfer main characteristics
• Safety principles
• Safety analysis</td></tr>
<tr><td rowspan="3">Unit 2 – Basic operation of a nuclear reactor (15 hours)</td><td colspan="2">Responsibility / Autonomy</td></tr>
<tr><td colspan="2">Operate a nuclear reactor (EQF=7)</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>Reactor operation
• Operational aspects – limitation of the reactivity
• Reactor start up and operation
• Temperature effect
• Core poisoning (Xenon, Samarium)
Practical course on the ISIS training reactor
• Fuel loading
• Approach to criticality
• Reactor start up and stabilization
• Manual and Automatic control
• Effect of the core loading modification
• Temperature effect
Practical course on a software application
• PWR normal and accidental conditions</td><td>• Approach and manage the reactor operation.
• Explain physics underlying the reactor operation.
• Operate an experimental reactor</td><td>• Reactivity variation and management
• Use of control rods
• Control rod efficiency measurement
• Main effects during core operation
• Complexity of a reactor system
• Links among the main reactor equipment
• Operational safety</td></tr>
<tr><td>Assessment criteria = to demonstrate mastery of basic nuclear reactor physics and operation</td><td></td><td></td></tr>
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Recommended assessment methods: Written test and/or oral face to face interview		

Course applicable for the following job profiles:

- 1.0.01: Nuclear Safety Manager
- 1.0.02: Safety Assessment Specialist
- 1.0.10: Safety Design Engineer
- 1.2.01: Design Manager
- 1.2.09. System Design Engineer
- 2.0.01. Plant Manager
- 2.1.03. Production Manager
- 2.1.06. Engineering Manager
- 2.1.07. Operation Manager
- 2.1.04. Training Officer
- 2.2.01. Shift Engineer
- 2.2.02. Senior Reactor Operator/CRO
- 2.6.01. Safety and Security Manager
- 2.8.07. Reactor Physicist