Nuclear competence building: past and future of nuclear engineering education

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20th BNEN MSc Academic year’s opening, SCK-CEN Mol (BE), 13 September 2021
EU/Euratom Challenges, Opportunities, Impacts

- Safe and harmonised management of radioactive waste
- Enhanced safety of design and operation of existing and future reactors
- Lift uncertainty about health risks after low radiation dose due to industrial and medical applications
- Ensure transfer of knowledge to future generation in the field
- Integration of European research programming and implementation
- Challenges need to be addressed worldwide

Euratom Treaty, EU Directives, E&T is a safety requirement
Euratom Treaty (1957), Community research and training programme

- Effective implementation of EU Research Area ERA in the field of nuclear fission, and exploiting the full potential of institutes, universities, industries and other organisations in these countries as regards their infrastructure, human resources and overall competences.
BNEN, ENEN - European Nuclear Education Network

1999 BOLOGNA declaration on a ‘European Higher Education Area’ ECTS → mutual recognition of academic grades
2002 COPENHAGEN on ‘Vocational Education & Training’ ECVET → Lifelong learning and cross-border mobility
2010 and following EU Communication ‘An agenda for new skills and jobs’ → free movement of KNOWLEDGE
together with PEOPLE, GOODS, CAPITAL AND SERVICES

• EFTS Euratom Fission Training Schemes, ECVET European Credit system for Vocational Education Training, EU Master or PhD programmes, common qualifications, mutual recognition, mobility of trainees/trainers and safety culture with an EC contribution towards Euratom projects and a European Nuclear Education Network ENEN

• University, Res. Org., Industry, TSOs, Reg. Bodies, Master in Nuclear Energy, Nuclear safety PWR, VVER Nuclear Radiochemistry and fuel cycle Radiation Protection, Health physics, medical experts Waste management and geological disposal Access to Key Infrastructures, Human Resources Observatory
European Master in Nuclear Energy (EMINE)

In the framework of the European Institute of Innovation and Technology – KIC InnoEnergy. 

Duration: 120 ECTS, over two years.

30 Scholarships per year

Language: English, Face to face education
Capitalising all initiatives

- Under Euratom, EC should promote and facilitate EU Nuclear safety R&D in MS, cooperation IAEA, NEA, GIF
- ETIPs Technology Platforms are industry led to promote R&D and demonstration of EU fission technologies
- EU fora supporting nuclear policy, promoting stakeholders dialogue and safety improvements
- ENEF from 2007 and WG Transparency, risks and opportunities
- ENSREG from 2007, stress tests peer reviews
- SNETP composed of NUGENIA, ESNII and NC2I pillars
- SET-Plan Key action n.10 on nuclear fission and fusion
- IGDTP on geological disposal, and EJP EURAD
- MELODI with NERIS-TP, EURADOS and Alliance
- ENEN European Nuclear Education Network, EHRO-N
- INCO structured dialogue on R&D policy and priorities
Contribution from nuclear to EU policies and SDGs

EC President von der Leyen Priorities

Targeted impacts for the von der Leyen political guidelines

Horizon Europe Missions

UN Sustainable Development Goals

Research and Innovation
2021-27 Overview of unifying activities EC RTD-JRC-ENER-INTPA

- Improving the safety of nuclear systems, including nuclear reactor and fuel safety as well as emergency preparedness, decommissioning.
- Contributing to the development of solutions for the nuclear waste management and for NPPs decommissioning, including final geological disposal as well as partitioning and transmutation.
- Fostering the development and sustainability of nuclear expertise and increasing excellence in the nuclear science base for standardisation.
- Supporting radiation protection and the development of medical applications of radiation, including the secure and safe supply and use of radioisotopes.
- Moving towards demonstrating the feasibility of fusion as a power source, laying the foundations for future fusion power plants by developing materials, technologies and conceptual design, and promoting innovation and industrial competitiveness.
- Ensuring the availability and use of research infrastructures of pan-European relevance.
- Improving nuclear security, including nuclear safeguards, non-proliferation, combating illicit trafficking, and nuclear forensics.
- Supporting the policy of the Union on nuclear safety and security.

Complementing EU Nuclear Safety and Decommissioning (LT, BG, SK) implemented by DG INTPA and New JRC

Decommissioning Programme
EU Nuclear Electricity Generation (PINC 2017) and 2050 strategy

Other important aspects with respect to HR requirements for nuclear experts at a European scale are the experts employed by the regulatory bodies, their technical support organizations, and in nuclear research, education, and training.

PINC - EU Nuclear Illustrative Programme

2050 Long-term strategy
HR STEM labour market and the demand by the EU nuclear industry by 2020

EHRO-N report
Nuclear Workforce in EU (2012)

- Existing workforce (no replacement of retired)
- New workforce needed for 60 years of NPP operation
- Available nuclear graduates (graduation rate of 2009)
- Number of operating NPP (60 years)
- Number of operating NPP (40 years)
Average Annual Construction Times

Sources: WNISR, with IAEA-PRIS, 2020
# Euratom Call 2021-22 Overview Schedule

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
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<tr>
<td>Drafting and Programme Committee WP2021-22 ...............</td>
<td>02/2020 – 02/2021</td>
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<td><strong>Adoption Euratom 2021-25</strong> ................................</td>
<td>05/2021</td>
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<tr>
<td><strong>Euratom WP2021-22 publication</strong> ..........................</td>
<td>07/2021</td>
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<td>Submission Call open...........................................</td>
<td>07/2021</td>
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<tr>
<td><strong>Deadline</strong> ....................................................</td>
<td>7/10/2021</td>
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<td>Evaluations ......................................................</td>
<td>10 – 11/2021</td>
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<td>Negotiations/Finalisation of Grants .......................</td>
<td>01 – 05/2022</td>
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<td>Grant Agreement signature...............................</td>
<td>06/2022</td>
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<tr>
<td>First projects launched .................................</td>
<td>06/2022</td>
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**EC Funding and Tenders portal**  [https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home](https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home)

**Horizon Europe and Euratom Info Days**  [https://www.horizon-europe-infodays2021.eu/](https://www.horizon-europe-infodays2021.eu/)
<table>
<thead>
<tr>
<th>Euratom 1-16 (Fission) and Other Actions (Fusion and others)</th>
<th>EUR million EC contr./prop</th>
<th>Total Budget (indicative)</th>
<th>Proposals (indicative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Safety of operating Nuclear Power Plants and Research Reactors (RIA)</td>
<td>3.0</td>
<td>18.0</td>
<td>6</td>
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<tr>
<td>2 Safety of advanced and innovative nuclear designs and fuels (RIA)</td>
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<tr>
<td>3 Multi-recycling of spent nuclear fuel from Light Water Reactors (RIA)</td>
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<tr>
<td>4 Advanced structural materials for nuclear applications (RIA)</td>
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<tr>
<td>5 Safety of High Temperature Reactors (RIA)</td>
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<tr>
<td>6 Harmonization of licensing procedures, codes and standards Fi/Fu (RIA)</td>
<td>2.5</td>
<td>2.5</td>
<td>1</td>
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<tr>
<td>7 Development of tritium management in fusion and fission facilities (RIA)</td>
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<td>3.0</td>
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<tr>
<td>8 Towards an aligned harmonized regulatory framework RWM and DECOM (CSA)</td>
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<td>3.0</td>
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<tr>
<td>9 European Partnership for research in radiation protection (COFUND)</td>
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<tr>
<td>10 Safe use and reliable supply of therapeutic radionuclides (RIA)</td>
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<tr>
<td>11 Cross-sectoral synergies and new applications of nuclear technologies (IA)</td>
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<td>10.0</td>
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<tr>
<td>12 European Facility in Nuclear Research (CSA)</td>
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<tr>
<td>13 Towards a European nuclear competence area (CSA)</td>
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<td>7.0</td>
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<tr>
<td>14 Socio-economic issues related to nuclear technologies (CSA)</td>
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<td>1.5</td>
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<tr>
<td>15 Support to Euratom National Contact Points (CSA)</td>
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<tr>
<td>16 Support to the Sustainable Nuclear Energy Technology Platform (CSA)</td>
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<td>0.6</td>
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<tr>
<td>Other Actions: GIF, FISA2022/EURADWASTE’22 ...Eurofusion (COFUND 537*)</td>
<td>0.7 .. 537 (fusion)</td>
<td>1</td>
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<tr>
<td><strong>Overall Euratom Fission 2021-22 Call indicative budget</strong></td>
<td><strong>99.6</strong></td>
<td></td>
<td><strong>29</strong></td>
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(* include budget from years 2023-25 fission (20), fusion (343))
Other Actions

- **Nuclear Innovation Prize (OA-03)** – to encourage European researchers to pursue excellence across a broad range of nuclear sciences and technologies. [https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/prizes/nuclear-innovation-prize_en](https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/prizes/nuclear-innovation-prize_en)

- **MSCA Postdoctoral Fellowships in research fields covered by the Euratom Programme 2021-2025 (Other Action OA-06)** – contribution to development of nuclear competences in the EU by provision of MSCA fellowships in fission and fusion research [https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-msca-2021-pf-01-01](https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-msca-2021-pf-01-01)

- **FISA2022 and EURADWASTE’22 Conference (OA-08)** – presentation and discussion of progress and key achievements of the latest Euratom projects

- **Other Actions**: external expertise (OA-04), ex-post and interim evaluation (OA-05), contribution to GIF (OA-07), communication actions (OA-10), support for Ukraine NCP (OA-11).
Mark your calendar - FISA2022 / EURADWASTE’22

François de La Rochefoucauld's assertion that "everything happens in France" is as true now as it was 350 years ago - global culture, fashion, food and football all have a distinct French accent.

http://europa.eu/european-union/eu60_en
Thank You!
Publications – CORDIS (EC R&D Information Service)

View all H2020 Euratom projects summaries and public deliverables on CORDIS
https://cordis.europa.eu/

H2020 Euratom projects (All)
https://cordis.europa.eu/search?q=contenttype=%27project%27%20AND%20(programme/code=%27H2020%27%20OR%20programme/code=%27H2020-Euratom%27)%20AND%20(%27euratom%27)&p=1&num=100&srt=Relevance:decreasing

... Latest relevant projects summaries!
Conferences’ Proceedings FISA 2019 / EURADWASTE ‘19 ... available!

FISA 2019 Proceedings

EURADWASTE ‘19 Proceedings

EPJ N Topical issues
- TOPICAL Edition
- AWARDS Selection
https://www.epj-n.org/
https://www.epj-n.org/component/toc/?task=topic&id=1234
https://www.epj-n.org/component/toc/?task=topic&id=1169

Romanian Presidency of the Council of the EU in 2019 Conferences
http://fisa-euradwaste2019.nuclear.ro/
FISA 2019 Presentations
http://fisa-euradwaste2019.nuclear.ro/fisa/
EURADWASTE ’19 Presentations
2021-27 Horizon Europe EUR 95.5 & Euratom EUR 1.98 Billion

**Euratom Research and Training**

Complementing Horizon Europe

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<th>(7 years)</th>
<th>(5 years)</th>
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<tr>
<td>Euratom Research and Training</td>
<td>EUR 1,980 million</td>
<td>EUR 1,380 million</td>
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**Indirect RTD**

- Fusion R&D: 809
- Fission R&D Safety and radiation protection: 370

**Direct JRC**

- Fission Safety and safeguards: 802

**ITER** (a dedicated EC Regulation, 7 years)

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<tr>
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<th>EUR million</th>
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<tr>
<td>ITER</td>
<td>5,610</td>
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**EU Council regulation Horizon Europe** [link](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0695&qid=1630764388794)

**Euratom Research and Training** [link](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.LI.2021.167.01.0081.01.ENG)

**ITER and F4E** [link](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021D0281&qid=1630764683246)

... Complemented by **EI-INSC** [link](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0948&from=EN)

**Decom NADP LT** [link](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0101&qid=1630767059180)

**Decom NADP SK, BG, and Decom JRC** [link](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0100&qid=1630767174312)

**And CBRNE Risk Mitigation Centres of Excellence** [link](https://europa.eu/cbrn-risk-mitigation/index_en)
EU/EURATOM Fission RTD Work Programmes

- **Waste Management and Geological disposal**
  - Decommissioning

- **Reactor systems**
  - Safety of existing nuclear installation (Gen II-III)
  - Advanced nuclear systems for increased safety (Gen-IV)
  - Partitioning, Transmutation and closed fuel cycle
  - Cross-cutting aspects (e.g. fuels, materials, simulation, nuclear data)
  - Other applications (e.g. cogeneration, support to Research Reactors)

- **Radiation protection**
  - Non-power applications

- **Research infrastructures**
  - Training and mobility
  - Cross-cutting INCO

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**Grand Total:**
- Euratom Fission RTD ~ 50 Mi€ / Year
- Euratom Fission JRC ~ 50 Mi€ / Year
- Total ~ 10 % EU Public&Private Fission R&D

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*European Commission*