



# PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

**PNRR 117 Research Field: INNOVATIVE NUCLEAR REACTORS: ENERGY SCENARIOS AND BUSINESS MODELS**

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1400.0**

In case of a change of the welfare rates during the three-year period, the amount could be modified.

## Context of the research activity

**Motivation and objectives of the research in this field**

The ecological transition is one of the key pillars of the EU policies as well as of the Italian recovery plan (PNRR). According to IPCC reports, the CO<sub>2</sub> equivalent emissions per kWh produced for nuclear are equivalent to wind power and lower than photovoltaic. In such a framework, new and innovative generation fission technologies (like Small Modular Reactors-SMR or Advanced Modular Reactors-AMR), may play an important role in generating CO<sub>2</sub>-free, reliable and programmable energy supply in the short run (within 2030-2035). Moreover, flexible operation and cogeneration capabilities (hydrogen, district heating, desalination, biofuels production, ...) allow SMRs/AMRs to be highly integrable with renewable energy sources. Those promising features justify the investigation of Innovative reactors deployment in Italian as well as European energy scenarios, and may trigger the development of new business models, involving since the beginning both utilities and energy intensive end-users. For the above-mentioned reasons, the motivation and objective of the research can be fully considered in line with the the topics targeted by DM 117/2023, in the Mission 4, Component 2 "From research to enterprise" (M4C2) aiming at increasing high-level skills for fulfilling the innovation needs of companies. More in detail, the proposed R&D activity is part of the Italian effort in the field, focusing on the SMR/AMR industrial, economic and



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|  | <p>financial features. Specific objectives of the investigation will be:</p> <ul style="list-style-type: none"> <li>• Construction of a long-term Italian energy scenario, considering the potential and possible development of nuclear generating technologies in the national energy mix, analyzing the economic effects linked to energy costs and their impact on the competitiveness of the industrial sector, as well as to the opportunity to create new supply chains and industrial districts.</li> <li>• Analysis of possible synergistic applications of nuclear technology in industrial fields (e.g. district heating networks, desalination processes, hydrogen production).</li> <li>• Analysis of new emerging nuclear technologies, in comparison with current, consolidated technologies, with particular focus on economic parameters and industrial development potential in a private financing context, including the analysis of feasible paths bringing the innovative technologies into a state of commercial availability, after the necessary demonstration phases.</li> <li>• Analysis of possible business models for an energy company acting as an industrial investor within the nuclear supply chain, with in-depth analysis of profitability prospects and associated risks.</li> </ul> <p>The R&amp;D activity may take benefit from the collaboration with EURATOM projects on similar topics, like TANDEM (<a href="http://tandemproject.eu">tandemproject.eu</a>), as well as with IAEA Planning and Economic Studies Section activities.</p> |
| <p><b>Methods and techniques that will be developed and used to carry out the research</b></p> | <p>A comprehensive approach will be adopted, to address the potential role of innovative nuclear reactors in the Italian/European energy mix. Energy scenario analysis (up to dynamic analysis) to evaluate SMR/AMR energy supply, cogeneration and energy service capabilities will be the main investigation method. The methods and techniques to be used will be of numerical-modelling type. Among the state-of-the-art codes: A2A proprietary modelling for the simulation and resolution of the Italian electricity market (taking into account in particular the economic equilibrium levels of the various generating</p>   |



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|  | sources);MODELICA (object oriented modelling); IAEA suite for energy planning (MAED, MESSAGE, WASP, FINPLAN, SIMFACTS, ISED).   |
| <b>Educational objectives</b>            | The PhD candidate will develop a comprehensive approach, devoted to address both the energy scenario identification and analysis, and the business model configuration. A critical analysis capability will be nurtured during the whole PhD programme. A further objective will be to gain a high-qualified know-how and expertise in the nuclear energy and innovative reactors area. The educational path of the PhD candidate on the main features of SMR/AMR, their behavior and interaction in the energy mix, will be developed together with A2A. Team working and problem solving capabilities will be key educational objectives as well.         |
| <b>Job opportunities</b>                 | The emerging candidate's profile will be highly attractive: in the research environment, where cross-disciplinary skills are more and more appreciated; in the expanding field of innovative, new generation nuclear reactors (where, besides large companies, also start-ups are emerging in the World, in Europe and also in Italy); in the nuclear as well as in the non-nuclear utilities, interested in evaluating the potentialities offered by innovative nuclear reactors; in the energy intensive industrial sectors, concerned about energy availability and affordability. EdF, CEA (FRA), VTT, Fortum (FIN), Tractebel-Engie (BEL), ENEA (ITA). |
| <b>Composition of the research group</b> | 1 Full Professors<br>2 Associated Professors<br>2 Assistant Professors<br>12 PhD Students   |
| <b>Name of the research directors</b>    | Prof. Marco Ricotti   |

| <b>Contacts</b>   |  |
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| <p>Phone +39-02-23996325<br/>                     Email <a href="mailto:marco.ricotti@polimi.it">marco.ricotti@polimi.it</a><br/> <a href="http://www.nuclearenergy.polimi.it">www.nuclearenergy.polimi.it</a><br/><br/>                     phd-STEN@polimi.it</p> |  |



| Additional support - Financial aid per PhD student per year (gross amount) |    |
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| Housing - Foreign Students   | -- |
| Housing - Out-of-town residents (more than 80Km out of Milano)             | -- |

| Scholarship Increase for a period abroad |         |
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| Amount monthly                           | 700.0 € |
| By number of months                      | 6       |

| National Operational Program for Research and Innovation   |  |
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| Company where the candidate will attend the stage (name and brief description)                       | A2A  |
| By number of months at the company   | 6  |
| Institution or company where the candidate will spend the period abroad (name and brief description) | Company, research center or university to be agreed with A2A |
| By number of months abroad   | 6  |

**Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information**

**Educational activities:** Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. The amount is about Euro 5700.

**Teaching assistantship:** Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

**Computer availability:** individual use.

**Desk availability:** individual use. Accommodation in Politecnico's Residences (<http://www.residenze.polimi.it>) is available for PhD candidates; special rates will be applied to selected out-of-town candidates (detailed info in the call for application).

**Research period abroad:** Our candidates are strongly encouraged (6 months minimum is mandatory) to spend a research period abroad, joining high-level, research groups in the specific PhD research topic, selected in agreement with the Supervisor. An increase in the scholarship will be applied for periods up to 6 months (approx. 700 euro/month- net amount).