POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 41st cycle

THEMATIC Research Field: ADVANCED SIMULATION AND KNOWLEDGE MANAGEMENT FRAMEWORKS FOR ACCELERATING THE NUCLEAR MATERIALS QUALIFICATION PROCESS

Monthly net income of PhDscholarship (max 36 months)
1500.0 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	As the global agenda for sustainable development and carbon emission reduction reshapes the role of nuclear energy in the future energy mix, there is a growing need for in-depth research into the behavior and qualification of materials used in advanced and innovative nuclear systems. Among these, molten salt reactors have attracted significant attention due to their potential advantages in terms of safety, efficiency, and waste reduction. Within this context, several international initiatives—such as the ENDURANCE project, coordinated by Politecnico di Milano—are focused on characterizing the thermochemical and thermophysical properties of selected salt compositions for use in advanced nuclear systems in the view of supporting the qualification process of these materials. This PhD research will contribute to this international effort through active participation in a round robin campaign aimed at benchmarking the properties of molten salts. The candidate will be responsible for developing modelling and simulation tools, both for front-end (predictive design) and back-end (data interpretation and validation) purposes, to support and complement experimental measurements. A key component of the research will involve conducting uncertainty analyses to quantify the reliability and reproducibility of the measured

	data, and to help formalize conclusions that can support the material qualification process. Beyond its application to molten salt fuels, the methodology developed in this project will be designed to be generalized to other classes of nuclear materials, including solid fuels and structural components. The broader objective is to advance simulation-driven knowledge management tools that integrate physics-based models, multiscale data, and uncertainty quantification, thus enabling faster and more robust licensing and qualification processes. This ambition aligns with and contributes to broader European research programs such as the CONNECT-NM partnership on nuclear materials, in which Politecnico di Milano is actively involved.
Methods and techniques that will be developed and used to carry out the research	Simulation tools such as OpenFOAM will be widely used in the activity, together with other tools for the simulation of molten salt fuel behaviour. Additional tools supporting the thermo-mechanical analysis are to be considered along the PhD project for solid materials, e.g., Abaqus or similar. As for the uncertainty analyses activities, reference available tools will be applied. A focus on machine learning and artificial intelligence methods is envisaged, including efforts towards interpretability and explainability of such methods.
Educational objectives	The PhD candidate will develop high-qualified skills and expertise in the nuclear energy &innovative reactors area, with a focus on materials behaviour. The presence of several international collaborations where the research activity is integrated will allow the student to interact with the main European and non-European institutions in this research field.
Job opportunities	The candidate profile will be highly attractive both in the research environment, where cross-disciplinary skills are more and more appreciated, and in the expanding field of fission energy system design, analysis, manufacturing and management.

Composition of the research group	1 Full Professors 3 Associated Professors 1 Assistant Professors 20 PhD Students
Name of the research directors	Stefano Lorenzi; Davide Pizzocri

Contacts
stefano.lorenzi@polimi.it davide.pizzocri@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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. This amount is equal to 10% of the annual gross amount, for 3 years. 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. Awards: Awards will be recognized to the PhD candidate up to Euro 1500 (gross amount) per year, in case of exceptional achievements in the research project, subject to the evaluation of the research director.