POLITECNICO DI MILANO

PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 38th cycle

PNRR_352 Research Field: ANALYSIS AND DEVELOPMENT OF SUITABLE DIAGNOSTIC METHODOLOGIES TO DETECT POSSIBLE CRITICAL POINTS ON THE MT NETWORK WITH A VIEW TO PREDICTIVE MAINTENANCE; USE OF SEMANTIC, BIG DATA, AND ARTIFICIAL INTELLIGENCE TECHNOLOGIES TO ANALYSE AND CORRELATE NETWORK DATA WITH OTHER SOURCES OF INFORMATION; REACTIVE POWER ANALYSIS VS. VOLTAGE AND IMPACT ON NETWORK ELEMENTS

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	This PhD position is proposed as a part of the National Recovery and Resilience Plan (PNRR), Mission 4, component 2 ("From Research to Business"), in accordance with the specifications of DM 352 of 09-04-2022. Specifically, the goal of scholarship is to carry out a research project in the area of the green transition and digital transformation pillars, as defined by Regulation (EU) 2021/241. The reliability and resilience of electricity distribution networks are among the main challenges distribution companies have to face. In recent decades, many regulatory authorities, including the Italian Regulatory Authority for Energy, Networks and the Environment (ARERA), have introduced performance-based regulations to incentivize distributors to effectively evaluate investments and preventive actions to improve the quality of the service offered to end customers. On the one hand, the distribution system operators (DSOs) can invest in network assets, developing and installing high-quality intelligent devices. On the other hand, DSOs have to investigate the reliability and resilience of their distribution networks, passing through a detailed analysis

	of the historical data related to failures and the variables most related to the disconnection events. To achieve the aforementioned innovative goals, the companies need highly qualified figures who have to combine academic knowledge with the company expertise. The research path will be mainly focused on the two following activities: • Develop an innovative medium voltage cable joint for underground electrical distribution networks. The research activity will be carried out in collaboration with one of the leading international manufacturers of electricity grid components. The prototype also requires developing real-time sensor data monitoring and communication for environmental and electrical parameters. The measurement system will be able to improve the DSOs reliability by enabling the use of algorithms aimed at introducing the concept of predictive maintenance of the assets. The design and approval phase of the prototype includes electrical tests according to current regulations and performance tests on the DSO electricity network. In addition, reliability analyses will be required to increase the performance of the prototype and business cases to improve the electrical distribution network reliability indices. • Analyze the available data of the remote control system and asset management tools to analyze and correlate these data, e.g., reactive power, currents, voltages, Petersen coil, technical data of the network and assets, number of failures, and failure modes, with the power quality. Based on the outcomes of the analysis, the goal is to introduce actions and solutions that can improve performance and guide the asset maintenance and replacement plans.
Methods and techniques that will be developed and used to carry out the research	System modeling through modern methods based on probabilistic procedure (Montecarlo-based), fuzzy logic, neural networks, genetic algorithms, chaos theory, game

	theory, and other theory system analysis. Moreover, traditional mathematical tools and programming, big data analysis, order reduction techniques, and semantic technologies may be used. For the lab activities, experimental approaches for the model validation and characterization will be used. The following entities are expected to cooperate in the research: University of Melbourne, Unareti, Arera, University of Washington, ABB. In particular, Unareti is directly involved and will provide data, expertise on the practical use of the tools developed, possibility to experience the real application to the distribution system operation and planning.
Educational objectives	Train researchers with high scientific qualification and autonomous research ability in the power system area: this includes specific skills in modeling technical and economic issues, simulations, critical analysis, and validation of results.
Job opportunities	The main opportunities are typically offered by R&D Departments of small and large innovative companies and manufacturers, research centers, transmission, and distribution operators, regulating authorities, and generation companies. Finally, academia is also an option.
Composition of the research group	5 Full Professors 4 Associated Professors 3 Assistant Professors 15 PhD Students
Name of the research directors	Prof. Alberto Berizzi

Contacts
Phone: +39 02 2399 3728 Email: alberto.berizzi@polimi.it

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

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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Unareti S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	University of Melbourne, Australia
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. 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. Thereare various forms of financial aid for activities of support to the teaching practice. The PhDstudent 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.