

Study programme Technology in Nuclear Power Engineering

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Faculty	Faculty of Mechanical Engineering
Type of study	Follow-up Master
Language of instruction	English
Code of the programme	N0713A270002
Title of the programme	Technology in Nuclear Power Engineering
Regular period of the study	2 years
Cost	50,000 CZK per semester
Coordinating department	Department of Mechanical Technology
Coordinator	prof. Ing. Ivo Hlavatý, Ph.D.
Key words	Legislation, Laws and Regulations in Nuclear Power Engineering, Welding Technologies, Small Modular Reactors (SMRs), Nuclear Power Plant Safety, Nuclear Power Engineering

About study programme

Nuclear power engineering is one of the strategic sectors of both the Czech and European industries. The construction of new nuclear power units, lifetime extension of existing nuclear power plants, the development of Small Modular Reactors (SMRs), and increasing safety requirements have created a growing demand for specialists combining expertise in nuclear power engineering with advanced mechanical engineering technologies.

The follow-up Master's degree programme Technology in Nuclear Power Engineering, offered by the Faculty of Mechanical Engineering at VSB – Technical University of Ostrava, prepares graduates for the manufacturing, installation, operation, diagnostics, maintenance, repair, and modernization of nuclear power plant equipment. The programme integrates nuclear power engineering with mechanical engineering, materials engineering, welding technologies, safety, legislation, and quality management.

Students acquire knowledge of nuclear power plant design and operation, manufacturing technologies for primary and secondary circuit components, advanced welding, non-destructive testing, diagnostics, material lifetime assessment, and the legislative framework of the Czech and European nuclear industries. The curriculum also includes Small Modular Reactors (SMRs) and modern technologies used in the production and maintenance of nuclear equipment.

Graduates are qualified for careers as manufacturing and design engineers, quality management specialists, technical inspectors, welding engineers, diagnostics and maintenance experts, research and development engineers, and specialists in nuclear safety and legislation.

If you are interested in advanced mechanical engineering and modern energy technologies and want to contribute to the future of nuclear power engineering, Technology in Nuclear Power Engineering is the right choice.

Professions

- Researcher
- Power engineering researcher
- Power plant system engineer
- Scientist and researcher of energy and heating facilities
- Power engineering auditor
- R&D engineer in the field of materials science
- Technologist
- Quality engineer

Hard skills

- Knowledge of methods for evaluating mechanical properties of technical materials
- Energy machinery and equipment
- Design of machinery components
- Knowledge of Czech legislation
- Knowledge of properties and applications of materials for energetics
- Nondestructive testing - ultrasound
- Knowledge of methods of non-destructive testing of technical materials
- Energy processes
- Knowledge of mechanical engineering technologies
- Nondestructive testing -magnetic tests
- Nondestructive testing -penetration tests
- Knowledge of non-destructive testing
- Nondestructive testing - penetration tests

Graduate's employment

Graduates of the study programme are employed by organizations engaged in the development, manufacturing, distribution, and servicing of engineering products, regardless of the size of the company. Career opportunities are available in both the mechanical engineering and nuclear power sectors. Graduates may also pursue self-employment in non-regulated professions, particularly in engineering consulting and technical advisory services.

The current demand of industry for Master's degree graduates specializing in engineering technologies and nuclear power engineering significantly exceeds the expected number of graduates from the Technology in Nuclear Power Engineering study programme, providing excellent employment prospects.

The Master's degree programme Technology in Nuclear Power Engineering integrates nuclear power engineering with technologies used in the manufacturing, installation, operation, and maintenance of nuclear power units. From a technological perspective, the programme focuses primarily on the manufacturing of nuclear power plant components and the application of advanced technologies for the repair, maintenance, and lifetime extension of existing nuclear power plants. An integral part of the curriculum is the study of nuclear legislation and regulatory requirements.

Through their knowledge of nuclear power engineering, manufacturing technologies, and the legislative framework governing the nuclear industry, graduates are well prepared for careers in both nuclear and conventional power engineering, the manufacturing of nuclear components, research and development of advanced technologies and materials, as well as nuclear safety and lifetime assessment of nuclear facilities.

Graduates may pursue professional careers in the following areas:

- nuclear legislation and regulatory compliance;
- quality management and the application of technical codes and standards, particularly in welding engineering for the nuclear and mechanical engineering industries;
- manufacturing of pressure-retaining components and equipment for the primary and secondary circuits of nuclear power plants;
- safety assessment and lifetime evaluation of nuclear power plant equipment;
- development and design of Small Modular Reactors (SMRs);
- engineering design and construction of nuclear power units in the Czech Republic and abroad;
- operation, diagnostics, maintenance, and technical support of nuclear facilities

Study aims

The follow-up Master's degree programme Technology in Nuclear Power Engineering integrates nuclear power engineering with mechanical engineering technologies used in the manufacturing, installation, operation, diagnostics, maintenance, repair, and modernization of nuclear power plant equipment. The programme focuses on the technological aspects of manufacturing key components of the primary and secondary circuits, quality control, diagnostics, repair, and lifetime extension of nuclear facilities, including their long-term operation.

The objective of this two-year follow-up Master's degree programme is to educate highly qualified professionals with advanced theoretical knowledge and practical skills in mechanical engineering technologies and their application in nuclear power engineering. Graduates will be able to solve technical and technological problems related to the manufacturing, operation, maintenance, safety, and modernization of nuclear power plant equipment in accordance with Czech and European legislation and international technical standards.

The programme focuses primarily on:

- manufacturing technologies, installation, and repair of nuclear power plant components;
- properties, degradation, and lifetime assessment of structural materials during long-term operation;
- advanced manufacturing, welding, diagnostic, and non-conventional technologies;
- quality control and quality management in the manufacturing and operation of nuclear power plant equipment;
- design, operation, diagnostics, and safety of nuclear power facilities;
- legislative, safety, and technical requirements of the Czech, European, and international nuclear industries.

Graduate's knowledge

The graduate of the study programme possesses comprehensive professional knowledge in the operation, safety, diagnostics, and management of energy systems and facilities, with particular emphasis on nuclear power engineering while also covering conventional power engineering. Graduates understand the principles of electricity generation in nuclear power plants, the design and operation of nuclear facilities, technological processes of the primary and secondary circuits, and issues related to the long-term safe operation of nuclear power units.

Graduates acquire in-depth knowledge of the utilization of nuclear energy, energy conversion and transformation processes, heat transfer and distribution systems, as well as the characteristics of current pressurized water reactors (PWRs) and emerging Small Modular Reactor (SMR) technologies. They gain expertise in the design, material, and technological requirements for nuclear equipment, including manufacturing, installation, quality control, maintenance, repair, and lifetime extension.

An important part of the graduate's professional profile is a thorough understanding of the legislative framework governing nuclear power engineering. Graduates are familiar with Czech and European legislation related to nuclear safety, radiation protection, and the operation of nuclear facilities, as well as the requirements of the International Atomic Energy Agency (IAEA), the standards of the Western European Nuclear Regulators Association (WENRA), and other internationally recognized technical regulations. They are also familiar with the design and manufacturing requirements of the ASME Boiler and Pressure Vessel Code, Section III, one of the principal international standards for the design and fabrication of nuclear components.

Graduates understand the broader relationships between energy, industry, and society, particularly the role of nuclear power in ensuring energy security, supporting decarbonization, maintaining the stability of power systems, and strengthening the energy independence of the Czech Republic and the European Union. Through elective courses, students may further specialize in industrial energy systems, operational measurements and diagnostics of energy equipment, or the environmental impacts of energy technologies.

In addition to specialized knowledge in nuclear power engineering, graduates possess advanced expertise in engineering materials, degradation mechanisms during long-term service, and advanced manufacturing, welding, inspection, and repair technologies used in the production and maintenance of nuclear power plant components. They also acquire knowledge of quality management systems, technical standards, and regulations applied in the nuclear industry, enabling them to meet the stringent requirements for the safety, reliability, and service life of equipment designed for operation exceeding 60 years.

Graduate's skills

The graduate of the study programme is able to analyse technological processes from both theoretical and practical perspectives, determine their optimal technological parameters, and apply advanced computational, simulation, and diagnostic software tools to solve engineering problems related to the manufacturing, operation, maintenance, and evaluation of equipment used in nuclear power engineering. Graduates are capable of interpreting the obtained results and applying them to solve practical engineering problems.

Graduates are qualified to solve complex engineering tasks both independently and as members of multidisciplinary teams. They are able to design technological procedures for the manufacturing, installation, welding, inspection, repair, and lifetime extension of

nuclear power plant components. They can apply their professional knowledge to the design, optimization, and evaluation of technological processes and actively participate in research, development, and innovation projects in nuclear power engineering and the manufacturing of energy equipment.

Graduates are proficient in technical terminology in both Czech and English, are familiar with technical, manufacturing, operational, and quality documentation, and are able to prepare technical reports, manufacturing procedures, technological documentation, and quality management system documentation in accordance with applicable technical standards and nuclear legislation.

Graduates are capable of performing experimental verification, diagnostics, and non-destructive testing to assess the technical condition of energy equipment. They can analyse and professionally present the results of operational measurements, technical analyses, and experimental investigations, applying them to optimize operation and improve the safety and reliability of nuclear facilities.

Furthermore, graduates are familiar with the design, material, manufacturing, and inspection requirements of the ASME Boiler and Pressure Vessel Code, Section III – Rules for Construction of Nuclear Facility Components, one of the world's leading standards for the design, manufacture, installation, inspection, and commissioning of nuclear facility components. They understand the fundamental principles of component safety classification, material selection, welding, heat treatment, non-destructive examination, quality management systems, technical documentation, and conformity assessment. These competencies are particularly relevant to the manufacturing of equipment for new nuclear power units and Small Modular Reactors (SMRs), where the requirements of the ASME Boiler and Pressure Vessel Code, Section III are commonly applied alongside European standards, the recommendations of the International Atomic Energy Agency (IAEA), and national legislation.

Through elective courses, graduates further develop their expertise in advanced energy technologies, the operation and diagnostics of energy equipment, manufacturing technologies for nuclear components, and the environmental aspects of energy production. They also acquire practical skills in applying Czech and European legislation, international nuclear safety recommendations, and technical regulations governing the design, manufacturing, quality assurance, inspection, and operation of nuclear power plant equipment, including components intended for future Small Modular Reactors (SMRs).

Graduate's general competence

The professional knowledge, practical skills, and transferable competences acquired by graduates qualify them for engineering positions in technical, operational, design, engineering, inspection, and management functions, as well as in quality management, manufacturing engineering, and process management within the mechanical engineering industry, nuclear power sector, and other industrial and non-industrial organizations. Graduates of the Technology in Nuclear Power Engineering study programme are particularly qualified for positions as technical and operational specialists at nuclear power plants, research and development engineers in nuclear technologies and Small Modular Reactors (SMRs), technical inspectors supervising the manufacturing and installation of nuclear equipment, inspectors, testing and certification engineers for nuclear components, and specialists in regulatory and supervisory authorities responsible for nuclear safety, such as the State Office for Nuclear Safety (SÚJB).

Graduates may also pursue careers in public administration, regulatory and supervisory authorities responsible for nuclear safety oversight, nuclear technical support organizations, and research and development institutions engaged in the development of advanced technologies, materials, and equipment for existing and future nuclear power plants, including Small Modular Reactors (SMRs).

Graduates of the study programme are able to:

- make independent and responsible decisions, even in partially structured and unfamiliar situations, based on general project requirements;
- coordinate the work of engineering teams within available resources and assume responsibility for project outcomes;
- consider technical, safety, economic, environmental, and ethical aspects when solving engineering problems;
- optimize welding, brazing, and thermal cutting technologies used in the manufacturing and repair of nuclear power plant components;
- apply advanced and non-conventional welding technologies, including metal additive manufacturing;
- implement technological procedures for the maintenance, repair, and replacement of nuclear power plant components;
- apply relevant legislation, technical regulations, engineering standards, and quality assurance requirements governing the nuclear industry;
- promote and comply with the principles of nuclear safety, radiation protection, and safety culture during the manufacturing,

installation, operation, and maintenance of nuclear facilities;

- communicate technical information and professional opinions clearly and effectively to both specialist and non-specialist audiences, particularly in the field of nuclear power engineering;

- use their professional knowledge, practical skills, and transferable competences in professional communication in at least one foreign language;

- independently acquire, develop, and critically evaluate new knowledge, practical skills, and professional competences through engineering practice, self-directed learning, technical literature, engineering standards, and legislative documents.