



Nuclear Department

The Nuclear Department (NUC) develops innovative tools, processes, products and design methods for fusion, safety, radiation protection, environmental and cultural heritage protection, security and in the medical field.

It collaborates with major laboratories in Europe, the USA, Korea, Japan and China, with public and private industry and institutions such as MiTE, MiSE, MIUR, MAECI, Euratom, IAEA, NEA, NATO, Fusion for Energy. It promotes international agreements for collaborative activities and for the training and education of young researchers. The department has filed over 50 patents in the last 20 years and carries out technology transfer activities.

STRATEGIC OBJECTIVES

- Research and development in the fields of fusion and superconductivity - Implementation of the Divertor Tokamak Test infrastructure
- Research and development of nuclear safety technologies. Support to the competent authorities (MAECI, MiTE, MiSE, IAEA and NEA/OECD) also in relation to non-proliferation treaties
- Management of the integrated service for the collection of non-electronuclear radioactive waste
- Metrology - performs the role of Primary Metrology Institute for ionising radiation; maintains and develops sample measurement equipment according to internationally recommended standards
- Research and development of technologies in the medical field for the treatment of cancer (proton accelerators and production of radiopharmaceuticals)
- Research and development of systems for security, detection of conventional explosives and protection against chemical, bacteriological, radiological and nuclear hazards (CBRN)
- Research and development of devices for the diagnostics and restoration of cultural heritage.

SUPPORT FOR BUSINESS CONCERNS

Technology transfer, support and involvement of enterprises are a priority of the Department, within the major international projects on ITER fusion, DEMO, Broader Approach and the commercialisation of plants based on technologies developed in ENEA for the nuclear, industrial, medical and security sectors. The Department is Liaison Officer towards Fusion for Energy (the European agency managing the European financial contribution for the realisation of ITER) and manages a database with over 500 SMEs to promote the participation of the national industrial system in the project. As National Programme Manager of the European Joint Programme EUROfusion for the implementation of the activities described in the Roadmap for Fusion in Horizon Europe, it represents Italy in the relevant Consortium.

Organizational structure

Nuclear Department

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our mission

“ENEA is a public body with the aim of pursuing research and technological innovation, as well as providing enterprises, public administration and citizens with advanced services in the sectors of energy, the environment and sustainable economic development.”

Law no. 22 of 28th December 2015

ENEA's mission is to contribute to Italy's competitiveness and sustainable development by conducting research and technology development activities in support of Public Administration, companies- particularly SMEs- and citizens.

ENEA comprises four Departments developing research, technology innovation and advanced services, with some 2,400 personnel composed of researchers, technicians and administrative staff distributed in 13 research centers throughout Italy.

ENEA has a long-standing experience in innovation and research in the fields of energy, new technologies and the environment.



ITALIAN NATIONAL AGENCY FOR NEW TECHNOLOGIES,
ENERGY AND SUSTAINABLE ECONOMIC DEVELOPMENT



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we research innovation



Nuclear Research

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- **Nuclear fusion** – Participates in international projects such as ITER and Broader Approach, in the design of DEMO and the intense neutron source IFMIF; coordinates Italian activities on fusion in Europe. Carries out theoretical and experimental research on plasma physics for magnetic confinement and inertial fusion. It is a leader in the development of superconductivity technologies and components for high thermal fluxes, the fuel cycle, controls and robotics, and neutronics. The construction at the ENEA Frascati Centre of DTT, Divertor Tokamak Test facility, a strategic infrastructure that will help solve the problem of disposing of the thermal power generated in the plasma, is part of the road map towards the construction of the first experimental reactor. DTT is expected to employ 1,500 people and invest EUR 500 million over seven years with the contribution of the international community.
- **Nuclear safety** – World scientific and technological reference in the field of nuclear safety. It participates in international projects to improve the coordination and sharing of protection and governance systems to minimise risks. Collaborates with institutions and participates in Euratom projects for the development of innovative reactors.
- **Applications of ionizing and non-ionizing radiation** – Develops technologies based on ionising and non-ionising radiation for applications in the surveillance of scientific and industrial facilities, including nuclear facilities, environmental protection, land exploration and cultural heritage protection.
- **Security, counter-terrorism and combatting fraud/infringements** – Develops detection systems for conventional explosives, protection against chemical, bacteriological, radiological and nuclear (CBRN) risks and participates in projects for counter-terrorism, also in the NATO sphere. It develops innovative technologies based on lasers, lidar and spectroscopic techniques for anti-seismic applications and anti-counterfeiting and anti-fraud controls, a sector particularly relevant to the quality of life and health of citizens.
- **Health** - Develops machinery for the targeted treatment of certain cancers (proton therapy), studies the possibility of producing radiopharmaceuticals using the TRIGA reactor with which it will be able to meet the needs of hospitals in the Rome area. The 'Sorgentina' project is being developed, the aim of which is to demonstrate the possibility of producing radiopharmaceuticals using fusion neutrons.
- **Nuclear Data** – The presence of the Triga and Tapiro research reactors and the Calliope Gamma and Frascati Neutron Generator fusion neutron sources has enabled the development of nuclear data bases of fundamental scientific importance and for supporting ministries in the management of international protocols. These sources are indispensable for the qualification of components and materials for scientific and industrial use.

Superconductivity

The Superconductivity Section has expertise and instrumentation for the growth of coated conductor (YBCO) and next-generation superconductors (iron arsenides), and for the characterisation of superconductive materials in general. Recently, in addition to the production of conductors for the poloidal and toroidal coils of ITER and JT-60SA, the Section is engaged in finalising the design of the conductor for the toroidal coil of DEMO. It is also in charge of the design of the entire superconducting magnetic system of DTT.

Innovative projects

This Section proposes, develops and experimentally validates new technologies, systems and innovative solutions for a safe, reliable, cost-effective and non-proliferating fusion and fission nuclear power plant. The activity takes place in the conceptualisation, design and implementation of new experimental infrastructures, in the modernisation of existing ones, working in support and in collaboration with the national industry operating in the field of advanced technologies. To this end, it participates in projects, consortia and research collaborations, both national and international, for the technological development of innovative nuclear systems, providing technology transfer services to the nuclear and energy industries.

National Institute of Ionizing Radiation Metrology

This Institute produces national primary standards for the measurement of ionising radiation (high/low dose dosimetry, radionuclides, neutrons). It oversees the calibration of measurement instrumentation and the organisation of comparisons between primary laboratories worldwide in the medical, environmental and nuclear sectors. It provides technical support to ACCREDIA. It has set up thirty experimental and radiation source lines for national primary sample development and calibration services. It provides internationally recognised certification of the calibrations performed. Role assigned to ENEA by Law No. 273/1991.

Plasma Studies

It carries out theoretical and experimental research on the fixed plasmas of fusion interest, both magnetic (support for the DTT Facility and experimentation on the ProtoSPHERA spheromak) and inertial (ABC laser). It participates in research activities on the experimental machines of the European and international fusion programme. He excels in the theory and simulation of hydrodynamics, waves in plasmas and their interaction with energetic particles. It performs R&D on tunable sources of power coherent radiation, laser-matter interaction, diagnostics and control of plasmas, particle and radiation detectors from microwaves to X-rays. It designs and builds radio-frequency power systems.



Experimental engineering

Activities include development of advanced nuclear systems (fourth-generation nuclear fusion and fission); management of experimental infrastructures of international importance, enabling work in the sectors of thermofluidodynamics of liquid metals and materials science; design and execution of experiments for validation of prototype components and systems; co-ordination, on a European level, of development of the water-cooled Breeding Blanket and technical development of lead-cooled fast nuclear reactors; operating as a leader in the field of liquid metals technology for nuclear applications; and teamworking to develop innovative materials for severe applications within the ambit of Europe.



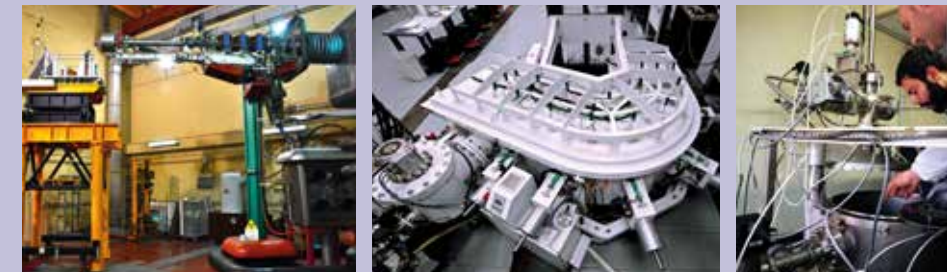
Technologies, facilities and materials for nuclear fission

This Division is operational in the sector of nuclear safety and security for next-generation nuclear reactors, and the sector responsible for closing nuclear fuel cycles. It acts as Integrated Service manager – originating in the 1980s, as per a decision of CIPE (inter-ministerial economic planning committee) –, in order to ensure safe, secure, controlled management of radioactive waste produced by industry, medical procedures and research. This Division runs the TRIGA-RC1 and RSV-TAPIRO reactors and the Laboratory for characterization of nuclear materials. It plays a part in national and international R&D programmes. The recent Progetto Molibdeno (molybdenum project) foresees construction of a technological infrastructure for production of radiopharmaceuticals for nuclear medicine at the Casaccia Research Center.



Development of fusion energies

The Division tackles the challenges of realising magnetic confinement fusion through research and development of innovative instruments, technologies and methods in numerous fields of application: from the design of structures for high neutron flows to the dissipation of the thermal load from the plasma, from the measurement of the flux and energy spectrum of the neutrons produced to the management of the fuel cycle and vision in hostile environments. It realises prototypes of instruments and systems through experimentation in its own laboratories with a particular focus on technology transfer processes and the training of new generations of researchers and technologists. It supports the Department Directorate in managing ENEA's participation in the scientific, technological and industrial activities of the EUROfusion Consortium, F4E and ITER. It cooperates with the Italian industrial system through know-how transfer and joint participation in ITER supplies.



Physical health and safety technologies

It studies, researches and develops technologies, materials, processes and products in the industrial sectors of optoelectronics and photonics through advanced applications of ionising and non-ionising radiation (lasers and incoherent light) in the entire range of the electromagnetic spectrum; surveillance and monitoring of scientific and industrial facilities, for environmental protection, land exploration and the protection of cultural heritage, for the safety of citizens in terms of prevention and protection (security and safety) and for health (radiotherapy and bio-medical diagnostics).



Nuclear safety, security and sustainability

Activities include development of methods to ensure the safety, security and sustainability of energy produced by nuclear fusion and fission, and closing the cycle for nuclear fuel, and in all sectors in which nuclear technologies are adopted; support for the Autorità di Sicurezza Nucleare (nuclear safety, security authority) through preparation of responses to emergencies that are accompanied by release of radioactivity of any kind; analysis of the sustainability of future medium- and long-term energy scenarios, on a national, European and international level; and providing assistance for safety and security studies and nuclear analysis of fusion facilities.

