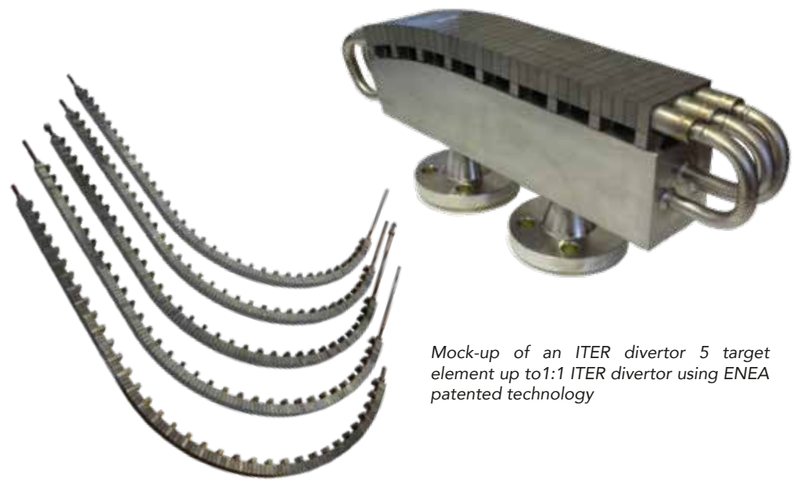
Tokamak FTU (Frascati Tokamak Upgrade) control unit housed by ENEA Research Center, Frascati



Mock-up of an ITER divertor 5 target element up to1:1 ITER divertor using ENEA patented technology

The large super conductor magnet coil for ITER, the global project developed with ENEA technology

Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

ENEA – Italian National Agency for New Technologies, Energy and Sustainable Economic Development – is the major Italian public institution for research, technological innovation and advanced services for energy, environment and sustainable economic development.

ENEA's applied research assets and the overall expertise of its researchers is put at the disposal of enterprises, public administration and citizens. Advanced services, research and technological products, as well as innovation processes are provided in some specialized fields, such as energy efficiency, renewables, nuclear fusion, new materials, environmental sustainability, seismic protection, cultural heritage conservation, agrifood, and green chemistry.

With its 9 Research Centres and 5 Research Laboratories, the Agency hosts 2600 staff employees and a network of 19 territorial offices all over Italy, which provide enterprises, public administrations and local realities with information and consulting services.

ENEA's presence in Europe is ensured by its Liaison Office in Brussels, which strengthens its participation in EU research programmes and international networks, such as EERA - European Energy Research Alliance – and EEN - Enterprise Europe Network – the largest service network fostering and supporting SMEs' competitiveness and innovation.

The Agency is organized into four main Departments: 'Fusion and Technology for Nuclear Safety and Security', 'Production and Territorial Systems Sustainability', 'Energy Technologies' and 'Energy Efficiency'.

To date ENEA has registered about 850 patents and has given rise to 11 spinoffs, acquiring a consolidated experience in managing complex scientific projects at national, European and international levels.

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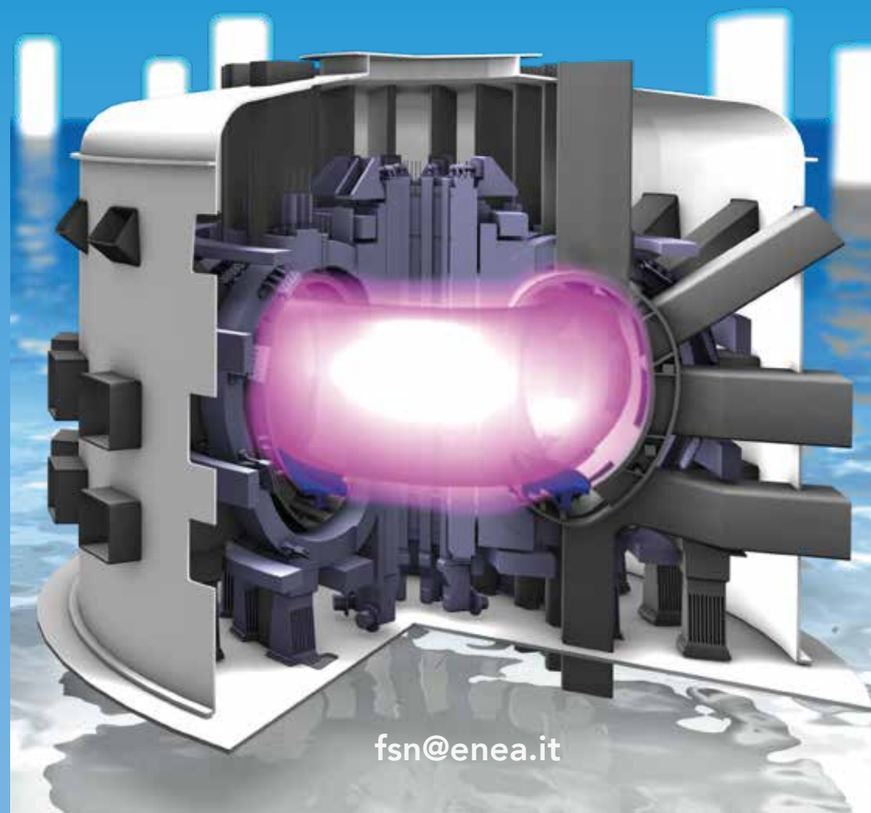
ENEA - REL PROM 8/2018

DTT Divertor Tokamak Test facility

Department of Fusion and Technology for Nuclear Safety and Security



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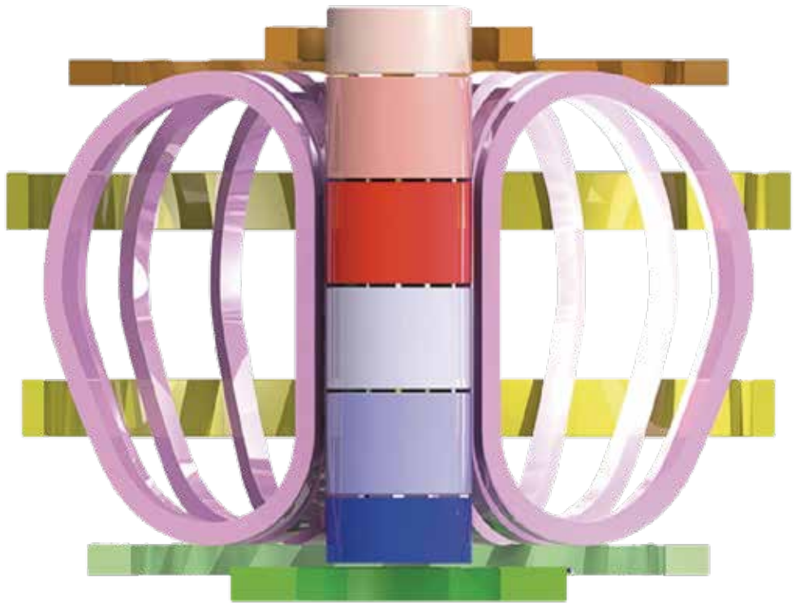
DTT
Divertor Tokamak Test facility

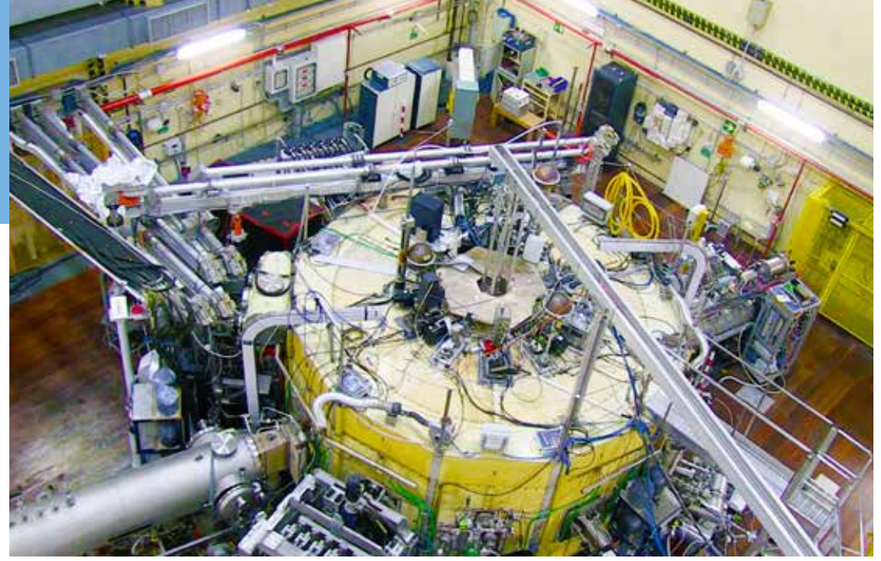
The DTT Project
an excellent fusion research lab

One of the most ambitious European research project in the field of energy production from fusion, is moving ahead: the construction of the Divertor Tokamak Test Facility (DTT), a strategic infrastructure in the roadmap to fusion, through sustainable solutions for de-carbonization, involving industries to promote advanced technology such as materials.
One of the largest European [1] science and technology laboratory, with national and private funding of over 500 million euro and the use of over 1500 highly qualified personnel, both directly and in the supply chain will be constructed in Italy and supported by EUROfusion, the European consortium managing fusion research activities.
Developed by ENEA in collaboration with the CNR, INFN, RFX Consortium, CREATE and some of the most prestigious leading universities of the sector, DTT was established as a connecting link between the major international nuclear fusion projects ITER and DEMO (the reactor expected to generate electricity from fusion energy by 2050) to provide scientific and technological answers to crucial issues such as the management of great power flows produced by plasma fuel and the materials to be used as a "container" capable of withstanding very high temperatures.

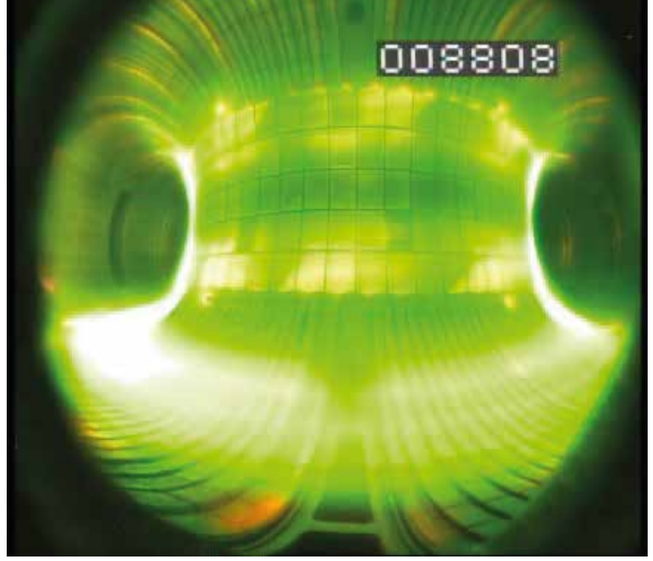
[1] Nuclear fusion is the exact opposite of nuclear fission, and it has the objective of producing safe, clean, inexhaustible and cheap energy capable of replacing fossil fuels, simulating the physics process that powers the stars.



DTT superconducting magnetic system diagram



FTU plant view - Frascati Tokamak Upgrade, in the ENEA Research Center, Frascati



Internal image of the FTU vacuum chamber during an experiment

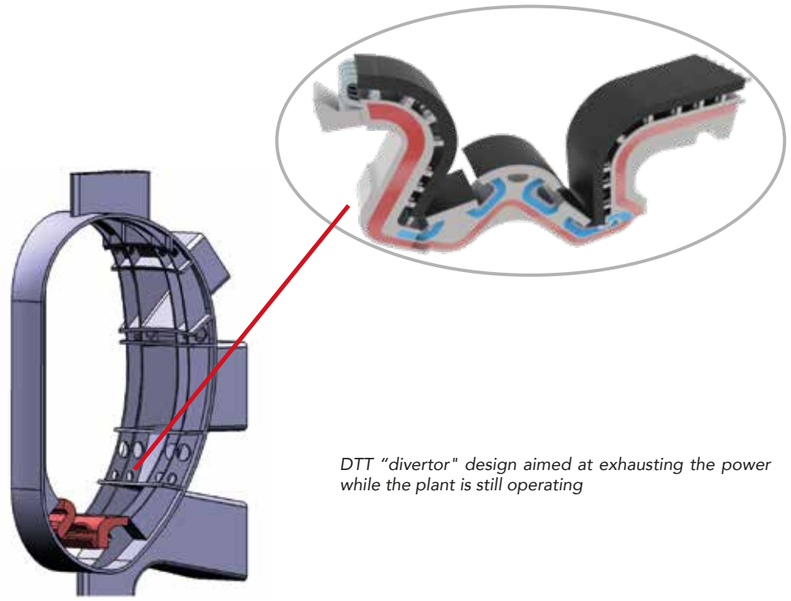
Cutting-edge technologies and benefits for companies

DTT is expected to have a significant impact on the whole scientific community and on Italian and European companies. As of today, fusion research has brought quite considerable results in scientific and economic terms, with important positive repercussions on Italian companies. ITER, for instance, involves over 500 italian companies, including Ansaldo nucleare, ASG Superconductors, (Malacalza Group), SIMIC, Mangiarotti, Walter Tosto, Delta-TI, OCEM Energy Technology, Angelantoni Test Technologies, Zanon, CECOM and the ICAS Consortium among ENEA, Criotec and Tratos, which have been assigned tenders corresponding to almost a billion euro, about 60% of the value of the european orders for high-tech components and the goal is generating new contracts for other hundreds of million euro in the next five years.
The underlying technology of DTT will be the same used for ITER [2], with the additional advantage of being able to perform tests using ENEA patented technologies. The D-shaped DTT will be a hyper-technological cylinder, ten meter high with a 5 meter radius, inside which 33 m^3 of plasma are brought to a temperature of 100 million degrees with a current intensity of 6 million amperes (equal to the current of six million lamps) and a thermal load on materials up to a dozen million watts per square meter (over double the power of a rocket taking off).
The "heated" plasma will work at a temperature of over 100 million degrees, while the 26 km of niobium-tin and the 16 niobium-titanium superconductors cables just a few centimetres away, will be at a temperature of 269° below zero. Thanks to last generation superconducting materials developed at ENEA in collaboration with industries of this sector, the plasma inside the DTT will reach an energy density similar to that of the future reactor. The target of the power source is the divertor, key element of the tokamak, subject to element thermal stress analysis Tungsten (W), which is considered a plasma-facing material for the divertor or liquid metals for innovative and advanced technology designs. The divertor can be removable and replaced only by means of advanced remote handling systems.

[2] ITER is a global project worth 20 billion euro, run by seven member countries (China, Japan, India, South Korea, Russia, USA and EU) conceived to demonstrate the feasibility of fusion energy in Cadarache, France. ITER is an experimental reactor which is 30 meters tall and weights 23.000 tonnes, expected to achieve power generation. It's one of the biggest and most complex engineering project at global level, based strongly on collaborations and synergies between research and industry in technologically advanced areas.

Italy leads the way in fusion research

Italy is leader in fusion research; our Country is among the main partners of the European Agencies EUROfusion and Fusion for Energy (F4E) and is part of the major international research programmes: DEMO, Broader Approach and ITER. ENEA is currently coordinator of the national research programme on fusion which plays an active role in the manufacturing of components within Broader Approach and ITER and collaborates with ICAS Consortium (Italian Consortium for Applied Superconductivity) and the industry.
ENEA Fusion and Technologies Department with its Frascati and Brasimone research centers is an internationally recognized reference point of excellence. Researchers at the Department were among the first to set up facilities for the study of magnetic confinement plasmas. In 1977, the first plasma in the FT (Frascati Tokamak) machine was manufactured and in service until 1989 when it was upgraded to (FTU) (Frascati Tokamak Upgrade).
Significant support is provided in power stations like superconducting coils, plasma-material interface, neutron source and safety, remote handling and fusion plasma physics. Over 50 patents have contributed to industrial development and competitiveness in the last 20 years in fusion research.



DTT "divertor" design aimed at exhausting the power while the plant is still operating