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Preface

In 2012 EFDA, the organization that preceded EUROfusion (European Consortium for the Development of Fusion Energy), has published "Fusion Electricity—A roadmap to the realisation of fusion energy", a path which outlines how to supply fusion electricity to the grid by 2050.

The document examines the open questions and proposes a roadmap arranged in eight main *Missions*. Among others, a relevant challenge (Mission 2 "Heat Exhaust") is the development of a complete and convincing plan for developing heat-exhaust systems capable of withstanding the large heat and particle fluxes of a fusion power plan.

It is an extremely complex and severe problem because the unmitigated heat flux, following the magnetic field lines at the edge of plasma onto the divertor surface, is expected to be even higher than on the sun's surface.

The theme involves many challenging aspects, including the choice and the development of materials, the definition of plasma equilibrium configurations, the design of the magnetic field in the divertor region, the real time diagnostic and control schemes and several others.

The baseline strategy for the accomplishment of Mission 2 consists of reducing the heat load on the divertor targets by radiating a sufficient amount of power from the plasma and by producing "detached" divertor conditions. This conventional solution will be tested in ITER. However, the risk exists that the baseline strategy cannot be extrapolated to a fusion power plant, where a much higher radiation fraction from the main plasma is required.

For this reason, in the framework of the roadmap toward fusion power plants, EUROfusion promoted two work packages, namely WPDTT1, to assess alternative divertor geometries and new plasma facing components, and WPDTT2, to define and design a new Divertor Tokamak Test (DTT) Facility.

Following the guidelines of the two work packages, a large team of about 100 researchers has developed a comprehensive and articulated proposal for the realization of a new facility (called Divertor Tokamak Test facility, DTT) to be built in Italy in the coming years, as an European infrastructure. It should be operated in parallel to ITER with the specific mission to provide satisfactory answers to the open questions regarding the power exhaust to be eventually implemented in DEMO. It should be a flexible, limited-cost, medium-size tokamak, accompanied by a well defined program of construction and operations in line with the EU fusion Road Map.

The proposal has been detailed in a report published by ENEA (Italian National Agency for New Technology, Energy and Sustainable Economic Development) in 2015 and presented to the scientific community in various international conferences in 2016. The proposal collected everywhere a wide interest with a strong encouragement to the realization of the program.

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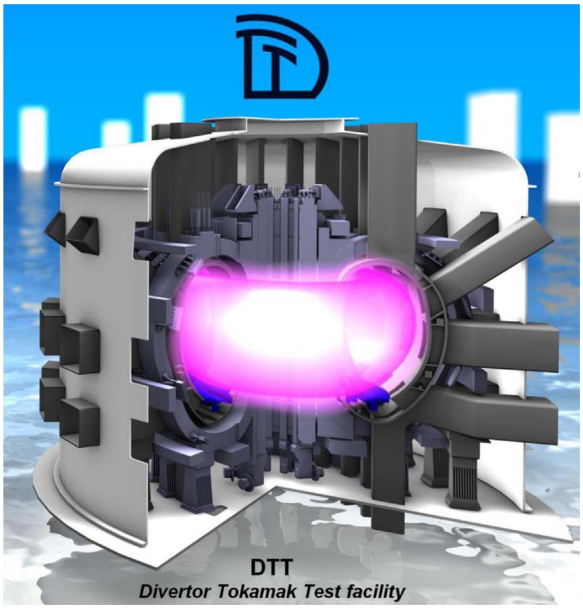

At present, the proposal is at the attention of the EUROfusion governing bodies in view of a possible organizational and financial support. A workshop is being organised under EUROfusion to discuss the programmatic goals of the proposal and get input from the European fusion research community. The proposal has also gathered the consensus and the support of the organs of the Italian Parliament and Government. In particular, the Standing Committee on Economic Activities, Trade and Tourism of the Chamber of Deputies unanimously gave a favorable opinion recommending the proposal, and the Vice Minister of Economic Development committed the Government to provide the resources requested in the budget plan.

This special issue of Fusion Energy and Design (FED) aims at collecting and critically discussing the results of the design efforts carried out in the recent past by the DTT Team, trying to provide the international scientific community with a coherent and organic view of this challenging proposal. The introductory paper is a general review of the main concepts and outstanding issues on power exhaust in tokamaks. Each of the other contributions is dedicated to one of the main aspects of the program, from the discussion of the technical and scientific basis of the proposal to the illustration of the construction of the facility, from the description of the operational plan to the discussion of all the economic and organizational elements of the project.

It has been promoted and organized by a group of Guest Editors (R. Albanese, F. Crisanti, G. Granucci, R. Martone, A. Pizzuto, P. Sonato) representing the main entities (ENEA, CREATE, CNR, Consorzio RFX) that have inspired the project, coordinated and supervised by an Overseeing Editor (R. Neu, Technische Universität München). However, without the generous and qualified effort of all the about one hundred researchers and scientists who contributed for the design of the facility and the preparation of the papers, this issue could not see the light.

An acknowledgment must be given to the Italian entities listed above for their support to the initiative with both financial contributions or high standard personnel and know-how. Thanks are due to the institutions that have supported the proposal (ENEA and its Third Parties, IPPLM, and KIT) and to those who allowed their professionals to give a contribution to the activities.

Warm thanks go also to the FED journal, which confirms its strong interest in the advances in research on nuclear fusion, in the belief that the DTT project can be a valuable opportunity for promoting an effective progress in the practical utilization of Fusion Energy.

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