Review of European Activities in Superconductivity for Thermonuclear Fusion, in the Light of ITER

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Abstract - Fusion research in the European Union (EU) is organized within the EURATOM treaty as a joint activity since its beginning in the 1960s. In it, superconducting magnet technology has been recognized as an important technological goal already in the 1970s. Since that time a substantial amount of effort on projects with increasing difficulty has been carried out in the different "associated laboratories". In most cases, project work was done together with European industry and also in international collaborations beyond Europe. Fusion-related activities started with the "Large Coil Task" (LCT) in the frame of a International Energy Agency program, and with the design and construction of toroidal magnet system for the French tokamak TORE SUPRA. A development project for poloidal field coils for very fast field changes followed. In parallel the design of a "Next European Torus" (NET) was started, already with emphasis on the superconducting magnet system and the development of relevant Nb3Sn conductors for high current and high field. For their testing, facilities were constructed for investigating at high fields and under mechanical load of up to full size samples - with currents of about 40 kA. With the establishment of the ITER design activity, the NET project and the NET team were terminated. The effort concentrated on ITER and the work was coordinated by EFDA, the newly created "European Fusion Development Agreement". Major activities concentrated on the development of conductors and the toroidal field coils. A big subtask for EURATOM was the fabrication and testing of an ITER toroidal field model coil (TFMC). For its testing, the coil test facility TOSKA, constructed at Research Centre Karlsruhe (FZK) already for the LCT, was upgraded and used. For conductor testing, beside facilities for strand and sub-size conductor measurements, the full-size conductor test facility SULTAN is playing an important role; it will be complemented with a dipole facility, which is being manufactured. After the decision in June 2006 to proceed with the construction of ITER, Europe decided to create the "Fusion for Energy (F4E) Joint Undertaking" to support the activity of the ITER construction. Beside the work for ITER, the superconductivity program contains also work for the magnet system of the modular stellarator W7-X and for the exploration of the use of HTS in fusion systems after ITER.

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