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The ITER Project, progress and prospects

The ITER project is a collaboration of 35 countries to build the world's largest fusion energy device, to demonstrate the feasibility of fusion power at an industrial scale. Recent years have seen rapid progress in construction, manufacturing, and – starting in mid-2020 – assembly phase. Currently, most of the overall work required to construct the plant has been completed. On the ITER worksite, this progress is visible firstly in the completion of key buildings and infrastructures. The tokamak building was declared ready for equipment as of Spring 2020. Commissioning of the connection to the EU grid and the substation for the steady-state electric network is complete; and commissioning of other key plant support systems (e.g., cooling water, cryoplant, pulsed power for magnet systems) is well underway.

On the tokamak manufacturing front, progress is equally impressive. The base and lower cylinder of the cryostat have been installed and welded together in the tokamak pit; the upper cylinder and top lid are also complete and in storage. The poloidal field (PF) coils PF6 and PF5 have been installed, and the four additional PF coils are completed. The first three modules of the central solenoid (CS) were delivered, and four more modules in various stages of manufacturing. All toroidal field (TF) coils have been delivered to ITER site, starting in April 2020. The thermal shield sections have been delivered, and the lower cryostat thermal shield has been installed. The first vacuum vessel sector arrived onsite in August 2020, and was pre-assembled together with two TF coils and a section of the vacuum vessel thermal shield. Two more vacuum vessel sectors, out of a total of 9, have been delivered.

With this progress achieved, ITER entered into Assembly Phase mid-2020, and the present years are now dominated by assembly, installation, system commissioning and integration. The path toward the achievement of the Q = 10 project goal is nevertheless still long. The Covid-19 pandemic has had impacts – both on the ITER worksite and in factories in Member countries – as well as the international situation; on the other hand, recent FOAK issues associated to the dimensional tolerance of the vacuum vessel sector bevels, as well as stress corrosion effects revealed on some of the thermal shield cooling pipes are causing some further delays for repairing. The so-called 2016 staged approach towards the Full Fusion Power is consequently under a project re-baselining exercise, aiming at minimizing the challenges on the scientific exploitation of ITER.

Highlights from each of these areas (manufacturing, commissioning, tokamak assembly) will be presented along with the updated status and plans. A particular focus will be made on the extensive use of radiofrequency based additional plasma heating systems, involving up to 80 MW, CW, at 170 GHz and up to 20 MW, CW, at 35-55 MHz.