Tokamak with Reactor Technologies (TRT): concept, mission, main features and the expecting performance characteristics

A.V. Krasilnikov1, S.V. Konovalov1,2, E.N. Bondarchuk1,3, I.V. Mazul1,3, I.Yu. Rodin1,3, A.B. Mineev1,3, E.G. Kuzmin1,3, A.A. Kavin1,3, D.A. Karpov1,3, V.M. Leonov1,2, R.R. Khairutdinov1,4, A.S. Kukushkin1,2

1Institution “Project Center ITER”, Moscow, Russia
2National Research Center “Kurchatov Institute”, Moscow, Russia
3JSC “Efremov Institute”, Saint Petersburg, Russia
4JSC State Research Center “Troitsk Institute for Innovations and Thermonuclear Research”,
 Moscow, Russia

Remarkable progress with REBCO high temperature superconductor technology happened during recent years provides possibility to design quasi-stationary Tokamak with Reactor Technologies (TRT) with high (Bt0 = 8T) axial magnetic field. High magnetic field provides to achieve burning (Q > 2) of the tokamak plasma at essentially diminished machine size (R = 2.15m, a = 0.57m) and accordingly cost. TRT will operate in quasi-stationary (100-150s) regimes with hydrogen, helium and deuterium plasmas (ne = 2\*1020 m-3) and with short (t < 10s) trace tritium discharges with Q > 2.

TRT is developing as full size plasma prototype for pure fusion reactor and Fusion Neutron Source for hybrid fusion-fission reactor. Missions of TRT are: development and integration in one machine the key fusion reactor technologies including: high temperature superconducting electro-magnetic system operating at extremely high magnetic field, metal and liquid lithium first wall and advanced divertor, several tens of MW and MeV range Neutral Beam Injection, 260 GHz MW-range gyrotrons, 60-80 MHz MW-range ICRH system, noninductive current drive system, tritium complex, experimental tritium breading blanket modules, remote control technologies, reactor relevant diagnostics, development and studies of the quasi-stationary plasma discharges, development and study of fusion plasma burning regimes with strong domination of alpha-particle plasma heating during trace tritium experiments.

Conceptual design of the TRT main components and its expecting performance characteristics have been developed and will be presented in the paper.