System Analysis of Negative Triangularity Tokamak Configuration with SYSCODE

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An innovative tokamak configuration with strongly negative triangularity was proposed as a promising operating scenario for fusion reactor in order to reduce divertor heat flux and improve stability [1], [2]. This configuration will make a large difference of structure comparing with standard tokamak. The system analysis research for negative trigularity tokamak configuration has been carried out based on the System Analysis Program for Parameters Optimization and Economic Assessment of Fusion Reactor (SYSCODE) developed by Institute of Nuclear Energy Safety Technology, Chinese Academy of Sciences· FDS Team.

The main functions of SYSCODE include: (1) Plasma physics calculation for ensuring the parameters of configuration, physics, performance, powers of core plasma and so on. (2) Engineering calculation for ensuring the heat and neutron loads on plasma facing components, and to build main structure model of tokamak reactor. (3) Economic calculation for assessing cost and economic efficiency of fusion reactor and related power plant. (4) SYSCODE also provides an optimization tool for system parameters analysis and optimization.

A typical configuration with large radius of 7m, minor radius of 2.7m, toroidal magnetic field of 6.2T, triangularity of -1.0, plasma current of 15MA , plasma current drive efficiency of 0.5m^{-2}A/W and effective charge number of 1.4 was preliminarily analyzed to obtain the global physics parameters in the case of H-mode. The initial results showed it could produce fusion power of ~1500MW with current driven power of ~90 MW within the MHD stability limit β_N=3 evaluated by Medvedev [3]. Its cost for fusion reactor was also assessed and compared with the standard tokamak fusion reactor with same component materials of ITER. We will also show some parametric survey of much higher fusion power regime as well at the conference. The equilibrium configuration and evolution will be simulated with TSC code.

Keywords: System Analysis, Negative Triangularity Configuration, System Code

[1] M. Kikuchi, T. Takizuka, M. Furukawa, JPS Conf. Proc., 015014 (2014)

[2] M. Kikuchi, A. Fasoli, et al., 1st International E-Conference On Energies 2014, E002; DOI:10.3390/ECE-1-E002, http://www.sciforum.net/conference/ece-1/paper/2321

[3] S. Medvedev, M. Kikuchi, et al., IAEA FEC 2015, PD/P5-1, submitted to Nucl. Fusion.