

## Computational Study of Non-Inductive Current Buildup in Compact DEMO Plant with “Slim Center Solenoid”

Y. Nakamura, K. Tobita, H. Tsutsui<sup>1)</sup>, Y. Takase<sup>2)</sup>, S. Nishio, M. Sato and N. Takei<sup>1)</sup>

*Japan Atomic Energy Research Institute, Ibaraki, 311-0193, Japan*

<sup>1)</sup>*Research Lab. for Nuclear Reactors, Tokyo Institute of Technology, Tokyo 152-8550, Japan*

<sup>2)</sup>*Department of Complexity Science and Engineering, The University of Tokyo,  
Chiba, 277-8561, Japan*

*E-mail: [nakamura@fusion.naka.jaeri.go.jp](mailto:nakamura@fusion.naka.jaeri.go.jp)*

Downsized “Slim Center Solenoid (CS)” option, which can not afford to provide sufficient Volt-sec for full plasma current buildup but to supply the coil current enough for plasma shaping, still offers fusion DEMO plant major cost benefits arising from its similar compactness to totally CS-less tokamaks. Therefore, plasma current buildup of the “Slim CS” plant is predicated on effective usage of high bootstrap (BS) current in addition to externally applied, non-inductive currents, substantially recovering the plasma equilibrium controllability lost in the CS-less concept. This paper describes a simulation modeling of hybrid current buildup scenario of high BS current, deformable plasmas directly coupled with the “Slim CS” and other shaping coils.

Stable formation property of strong internal transport barrier (ITB), which results in valuable increase of the BS current, was investigated via axisymmetric MHD simulations of 0.5-14 MA/1200 seconds, non-inductive buildup scenario of the DEMO plant using Tokamak Simulation Code (TSC) [1]. It was shown that the sufficient BS and external non-inductive currents can afford both to buildup the plasma current and to recharge the “Slim CS” coil current for the plasma shaping, meeting requirements from non-inductive techniques and confinement, MHD physics. However, a higher BS current buildup than ~60 % of the whole plasma current exhibits a strong interplay of the BS and external non-inductive currents via magnetic shear profile. This new effect leads to oscillatory ITB formations, making harder to attain the monotonic current buildup. The discharging and/or recharging controls of the “Slim CS” coil current will be also presented in the forthcoming TM.

[1] S.C. Jardin, N. Pomphery and J. Delucia, J. Comput. Phys. **66** (1986) 481.