

Progress in Conceptual Study of China Fusion-based Hydrogen Production

Reactor

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Abstract

As one of the series of fusion system design concepts developed by the FDS Team of China, Fusion-based hydrogen production reactor (FDS-III) is designated to exploit the fusion energy advanced application for the production of hydrogen, and satisfy fusion development strategy in China.

FDS-III is a cost competitive reactor concept with a fusion power of $\sim 2.5\text{GW}$, whose parameters are selected based on the progress in recent magnetic confinement fusion. The neutron wall load of $3.5\sim 4\text{MW/m}^2$ and the surface heat flux of $\sim 0.8\text{MW/m}^2$ are considered for high effective energy conversion. An innovative high temperature liquid lithium–lead blanket (HTL) concept based on the Reduced Activation Ferritic-Martensitic steel (RAFM) as structural material is proposed as an option of the blanket concepts for FDS-III. The “multilayer flow channel inserts (MFCIs)” have been adopted in the LiPb channels to attain high outlet temperature about $1000\text{ }^{\circ}\text{C}$ to satisfy the need of high efficiency production of hydrogen. The blanket combines advantage of the banana segment and large module to improve maintenance efficiency and reduce effect of electromagnetic force. The maintenance scheme considered is based on the removal of blanket segment and divertor cassettes through the big equatorial ports. In order to achieve a high energy conversion system, a carbon dioxide Brayton cycle is adopted which permit a high thermal efficiency. Preliminary cost analysis show FDS-III is a competition fusion reaction for hydrogen production.

This paper gives the preliminary design and study of FDS-III.

Key words: Hydrogen production reactor; High temperature blanket; Maintenance scheme; Energy conversion