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A novel supercritical CO2 power cycle for energy conversion in fusion power plants

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Abstract-

A domestic research program called TECNO_FUS was launched in Spain in 2009 to support technological developments related to a dual-coolant (He/Pb-Li) breeding blanket design concept. One of the goals of the project was the analysis of a suitable power conversion system with an enhanced coupling with the reactor heat sources. Each source has a different thermal level which generates many problems in the coupling.
In previous works the authors have explored enhanced power cycles, taken from literature, which solve the differences in the thermal levels of the sources with combined or dual cycles. Although these cycles reach high efficiencies (between 45% and 47%) their layout is very complex and the use of steam is required.
In this paper a new power conversion cycle is proposed. It avoids the use of complex layouts, being a variant of the supercritical CO2 Brayton cycle matched to the available thermal sources through an extra recuperator. The basic supercritical CO2 Brayton cycle has been also analyzed for comparison. The new cycle has been optimized so that efficiencies above 47% have been achieved.

Index Terms- Blanket designs; Domestic research; Fusion power plant; Power conversion cycle; Power conversion systems; Supercritical CO; Technological development; Thermal source

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