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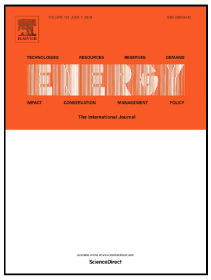

Key issues and solution strategies for supercritical carbon dioxide coal fired power plant

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Key issues and solution strategies for supercritical carbon dioxide coal fired power plant

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Abstract: When supercritical carbon dioxide (S-CO_2) Brayton cycle is used for coal fired power plant, the significantly increased flow rate causes extremely large boiler pressure drops, and residual flue gas energy extraction becomes difficult. This paper contains two consecutive parts to resolve these issues. The first part deals with general analysis. Results show that, introducing intercooling and/or reheating into cycle apparently elevate thermal efficiencies, but cycle performance is obviously deteriorated by large pressure drops. Partial flow strategy was proposed in part 2 to yield boiler module design. Both flow rate and length for each module are cut to be half, reducing pressure drop to 1/8 of that with total flow mode. Surprisingly, we show that CO_2 boiler pressure drop can be equivalent to or even smaller than that for supercritical water-steam boiler. Three flue gas energy extraction schemes are proposed. The case A scheme not only keeps lower exit flue gas temperature (~120^{o}C), but also maintains acceptable secondary air temperature. Finally, a 1000 MWe S-CO_2 power plant design is given. With main vapor parameters 620^{o}C/30MPa, thermal efficiency and power efficiency are 51.22% and 48.37% respectively, showing advantages over supercritical water-steam Rankine cycle. Future works are recommended on S-CO_2 power plant design.

Keywords: Supercritical CO_2; thermodynamic cycle; intercooling/reheating; pressure drop; heat transfer; flue gas.