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## **PRACA DOKTORSKA**

**Analiza termodynamiczna i ekonomiczna bloku węglowego  
na parametry ultra-nadkrytyczne z turbiną pomocniczą**

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# Thermodynamic and economic analysis of an ultra-supercritical coal-fired power unit with an auxiliary turbine

## Abstract

The objective of the work was to assess the possibility of further increase of the efficiency of electricity generation by modifying the structure of the coal-fired power units. The idea of the steam cycle with the auxiliary turbine (AT) consists in shifting all the steam bleeds from the IP turbine to AT, which fed with steam from the exhaust of the HP turbine. This solution leads to reduction in the temperature difference in feedwater heaters and decrease the losses associated with the entropy generation. The thermodynamic analysis was performed for the conceptual advanced ultra-supercritical 900 MW power unit for the cycle configuration with a single and double reheat and AT. Additionally, the thermodynamic analysis was performed for the another power unit structures: parallel and series cooling of condensers, various configuration of the cycle with the external desuperheaters of high temperature bleed steam. In the work the analysis of the power unit operation under part load was also presented. A comparison of various FWP drive options was conducted: electric drives with variable speed in two configurations (2xEM and 3xEM), the condensing turbine and AT. For the considered cycle configurations, with and without AT, the analysis of the impact of the power unit integration with the CO<sub>2</sub> capture installation (wet chemical absorption MEA) was performed. The economic analysis of selected power unit configurations was carried out. Application of AT can only slightly increase the efficiency of the electricity generation, but also can reduce the investment cost. As a result, the power unit configuration with AT achieves favorable economic indicators.

