POLITECHNIKA ŚLĄSKA

WYDZIAŁ INŻYNIERII ŚRODOWISKA I ENERGETYKI

Dyscyplina naukowa: Inżynieria środowiska, górnictwo i energetyka

Rozprawa doktorska

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Optymalizacja struktury układów technologicznych do wykorzystania ciepła produkowanego przez wysokotemperaturowe reaktory jądrowe HTR na potrzeby produkcji energii elektrycznej i ciepła z wysokosprawnej kogeneracji w istniejących polskich elektrowniach i elektrociepłowniach

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Abstract

Commercial power engineering and heating in Poland have been a guarantee of security of heat and electricity supplies for many years. Changing environment, the need to adapt to new market conditions and geopolitical situation and the policies of the European Union are shaken by the well-established stability and position of domestic energy producers. Poland has the largest share of fossil fuels in the production of electricity and heat in the European Union and has the most difficult task of all member states in terms of decarbonising the energy and heating sectors. Large energy concerns in Poland, such as Tauron, are looking for solutions that would enable acceleration of the decarbonisation process and the fastest possible reduction of carbon dioxide emission rates, and thus lowering the costs of energy production. For large energy companies in the country, decarbonisation does not have to mean the liquidation of existing generation fleet. With the use of modern nuclear technologies, it is possible to replace the coal boiler with a modular nuclear reactor, which will supply steam with appropriate parameters to the existing steam turbine. The Tauron Group is analyzing the possibilities of founding nuclear facilities in order to use them for the purposes of securing the heat markets it serves. As part of this study, the possibility of technological connection of the existing infrastructure of the heat and power plant in Tychy and the heat and power plant in Katowice was considered with the project of a high-temperature HTGR reactor with a capacity of 180 MWt. The results of the analysis show the possibilities of adapting existing installations to the parameters of the factor supplied by the nuclear reactor. The energy and mass balance calculations of such systems were carried out for various variants (heating season and condensation). The possibility of using the excess energy from the high-temperature reactor to supply cooling devices was also considered, which enables the enrichment of typical cogeneration systems with trigeneration systems that can supply heat and cold as well as electricity at the same time or depending on the season, heat or cold separately. The change of a classic power plant consisting in the use of a heat source without emission and the implementation of polygeneration improves its operating parameters, especially in terms of environmental and efficiency. The polygeneration installation has a high rate of primary fuel energy savings through a high combination of electricity, heat and cooling production, which allows it to apply and use the available support system, which is the cogeneration bonus.