

热电联产机组结合电锅炉灵活性改造方案的分析

摘 要

当前中国“三北”地区电网在冬季时会面临大量弃风现象，针对这一类现象提出了对热电机组结合电锅炉的灵活性改造方案，用来解耦“以热定电”约束，从而起到消纳弃风的作用。通过了解储热电锅炉工作原理，分析不同的运行方式下的调峰能力，以 300 MW 机组为例，建立火电机组一次调频模型，研究蓄热水罐和蓄热电锅炉配置方案对于热电机组一次调频能力的影响。

首先，在研究热电联产机组结合电锅炉的灵活性改造中，对比分析配置电锅炉后的调峰能力，创建了关于节煤效益评估和国民经济性的数学模型，研究各类因素对它的影响。其次，为了分析热电机组结合电锅炉改造的经济性，在政府对东北市场的辅助下，建立了关于下调峰的成本效率模型，以及将投资回收期为指标的投资经济评估模型。最后，建立关于电锅炉不同容量选择和运行的计算优化模型，根据热力发电厂的热经济性评估办法，对机组的电热特性进行研究分析，并制定解出热电机组调峰经济最佳运行工况的方法。本次研究结果说明，不同的机组有着不同的最佳工况，每台热电机组都有最适合自身的配置方案；配置电锅炉具有明显的节煤效果和国民经济可行性；在当前调峰机制下的中小规模弃风，在供热中期热负荷较大时，减少机组最少出力可降低电锅炉的配置容量，计算出电锅炉的最佳容量配置和最小消耗功率，项目投资和运行成本大量减少。

关键词：电锅炉；热电机组；一次调频；风电消纳；经济性

Analysis of flexible transformation scheme on electric boiler for cogeneration units

Abstract

In view of the problem of wind abandoning in the winter heating period of China's "sanbei" power grid, a scheme is proposed to decouple the constraint of "heat determining power" by installing electric boilers in thermal power plants, so as to reduce the consumption of wind abandoning power by forced output. By understanding the working principle of thermoelectric storage boiler and analyzing the peaking capability under different operating modes, the primary frequency modulation model of thermal power unit was established by taking 300 MW unit as an example, and the influence of the configuration scheme of thermal storage water tank and thermoelectric storage boiler on the primary frequency modulation capability of the unit was studied. When analyzing the peak-shaving capacity of the thermoelectric unit equipped with electric boiler, we first understand the basic operating principle of the scheme, establish a mathematical model to evaluate the coal saving benefit and national economy of the scheme, and analyze its influencing factors. In order to analyze the economy of electric boiler reconstruction, the operating cost and benefit model of lower peak-shaving is established in the background of the northeast peak-shaving auxiliary service market, as well as the economic evaluation model of investment based on the investment payback period. Based on the actual data, the economy of typical thermoelectric units in northeast power grid under different scenarios is calculated and analyzed. A calculation model for capacity selection and operation optimization of electric boiler was established, and based on the thermal economy evaluation method of thermal power plant, the analysis and research on the thermal characteristics of units were carried out, and the strategies for solving the economic operating conditions of peak-load units were formulated. The results show that different configuration schemes have different effects on the primary frequency modulation capability of thermal power units at different time periods. The electric boiler has obvious coal saving effect and national economic feasibility. Under the current peak-shaving mechanism, when the heat load is large in the middle heating period, reducing the unit's minimum output can reduce the configuration capacity of the electric boiler and determine the optimal capacity configuration and minimum power consumption of the electric boiler. After

optimization, the project investment and operation cost can be significantly reduced.

Keywords: Electric boiler; Cogeneration units; Primary frequency modulation; Consumption of wind power; Economy

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