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Operation and Economy of a Refuse-Fired Generating System with Electricity Wheeling Service

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SUMMARY

Electric power markets have been partially liberalized and liberalization will be proceeding steadily. On the other hand, refuse-fired generating systems (RGS) are constructed in many municipal corporations as on-site power sources. This paper discusses the operation of an RGS which can transfer its excess energy to consumers through the electricity wheeling service of the electric utility. The RGS is operated by the dynamic programming method under the constraints of RGS operation and electricity wheeling service. In the DP method, the estimation function is the annual total electricity charge of both the RGS and the consumers, and the control variable is the residual amount in the refuse pit. A university, hospitals, welfare apartment houses, and their combinations are selected as consumers. The main results obtained are as follows: (1) electricity wheeling service is more economical than the absence of electricity wheeling service when the annual demand of the consumer is higher than 70% of the excess energy of RGS; (2) it is more economical as the load factor increases if the annual demand is the same; (3) the most economical consumer is the combination of four hospitals and five welfare apartment houses, for which the total electricity charge can be reduced to 84% of that in the absence of wheeling service. It is concluded that the total electricity charge of the RGS with electricity wheeling service could be decreased considerably by selecting the consumers appropriately. © 2003 Wiley Periodicals, Inc. Electr Eng Jpn, 146(1): 59–69, 2004; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/eej.10211

Key words: waste power generating system; liberalization of electric power market; electricity wheeling; dynamic programming; electric load energy; load factor.

1. Introduction

In the context of increasing use of energy alternatives to oil, waste power generators are being developed extensively along with solar and wind power generating systems. Waste power generating systems are used mainly at large-scale waste incineration facilities in metropolitan areas, and their total output reached 9.7 million kW in 1997 [1]. The Agency of Natural Resources and Energy is planning to achieve 50 million kW by 2010 [1]. For the future expansion of waste power generation, such systems must be introduced at medium-scale waste incineration facilities as well.

An important factor in the economic performance of waste power generation is the unit selling price of excess power supplied to an electric company. At the moment, the price is about 12 yen per kWh in the daytime, but drops as low as about 2 yen at night [2]. There are some studies on the economics of waste power generating systems under such a rate system [3, 4].

On the other hand, liberalization of the energy retail trade is taking place in the global context of market deregulation. At the present stage, liberalization is applied only to consumers who receive power at extrahigh voltage, but in the future it will probably be extended to small- and medium-scale factories, buildings, and other facilities.

This study deals with the economics of power wheeling when a waste power plant provides electricity to small- and medium-scale consumers.

Medium-scale waste incineration facilities are considered as sites for the implementation of waste power generation, while schools and hospitals, welfare-based apartment houses, and other facilities are considered as recipients of wheeled electricity. In such an environment, the economical operation of a waste power generating system is designed using dynamic programming with regard to various constraints, and the overall annual cost is