CONCERNING TEMPERATURE LOSS AND TRANSMISSION DELAY ANALYSIS FROM MICROGRID CCHP THROUGH THERMAL FEATURES OF HEATING NETWORK

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Abstract

In traditional optimum dispatch by combined cooling, heating and power (CCHP) of microgrid control heat power balance are measured but neglecting characteristics of heating networks which dispatching result by practicing value and decreasing the economy. The research proposed a thermal characteristics of heating process are modeled on the source of temperature loss concerning and transmission delay to pipelines. The proposed method considered on equipment safety, thermal characteristics, and load balancing microgrid of CCHP is developed by aiming to dispatch the optimization model to minimize a daily operational cost for process. Temperature loss and Transmission delay are two fundamental characteristics of heating network, which must be measured when enhancing CCHP microgrid operation system. Finally simulation results established the dispatching proposed model fully exploit heating network with capability of thermal storage and heat load profile has been change and thereby deliver more practical and economical dispatching solutions. Therefore, heating network of thermal characteristics must be taken into account when processing a method of dispatching a CCHP microgrid.

Keywords: Combined cooling heating and power, Heat network model, Microgrid, thermal characteristics, and optimal dispatch.

I. INTRODUCTION

The energy management of combined cooling, heating and power (CCHP) microgrid is considered by both supply and demand side. Established a CCHP microgrid load decrease an energy management of other units and storage devices according to the working characteristics. CCHP systems can supply power, cooling and heating simultaneously in a mode of energy cascade utilization, which can improve pollution emission, reduce energy costs and energy efficiency [1].

Therefore in the more and more attracted area of energy is CCHP in the attention level of process. In the building the heating and cooling system are more demand in the scenarios of modern building with coincide of building through algorithm of CCHP [2]. The CCHP microgird are called when CCHP is applied in the building. At present, there are large number of literature have been studied problem in the optima dispatch of CCHP microgrid.

Emission of carbon dioxide, primary energy consumption to achieve a minimum operating cost. Reliability control of CCHP microgrid based on probability of stochastic multi-objectives of optimization model [3]. Based on the Hessian interior point technique is developed under CCHP microgrid of optimal dispatching process that divided heating, cooling and electric that load five types of process [4]. Literature [5] subsequently developed an optimal dispatch of general model is proposed and bus based structure are described the energy flow and composition of CCHP microgrid.

However, neglecting a thermal characteristics of heating network [3-5], which practice ideals of the dispatching results and comprise the economy. Literature [6] provides the description of simple variables and calculating heating network and examines thermal characteristics of heating network. Literature [7] proposes a combination model to entirely simulate the dynamic temperature distribution of a actual heating network and builds a advanced model of heating network.

Literature [8] develops an optimized scheduling model of the CCHP microgrid, in which characteristic thermal storage capacity is exploited to provide accommodations wind power. Exploits complementarily characters between demand response realizing a synergic dispatching of heat, cold, and electric power, and transmission delay of heating network, [9]. In this paper, thermal characteristics of heating network are modeled with considerations of transmission delay and temperature loss concerning to pipelines.

Then, a dispatch optimization model aiming to minimize daily operation costs of the CCHP microgrid is developed. Simulation results determine that the dispatching model proposed in this research can fully exploit thermal storage capacity of heating network and change the heat load profile, and thereby bring solution of more economical and practical dispatching.

II HEATING NETWORK THERMAL CHARACTERISTICS MODULE

Thermal energy of Heating network from the source of heating loads through pipeline by medium heating, that can be divided according to the medium heating adopted process of transfer heat into steam and hot water network. Due to the modest heating area between the stations exchanged the heat without any load of heat which was directly connected to the equipped in building with heating network of CCHP microgrids. In accumulation heating network is measured in the quality instruction mode, which means that network of heating masses are fulfilled by adjusting the supply temperatures of heat sources, while ensuring the circulating flow rates in all pipelines are continuous.

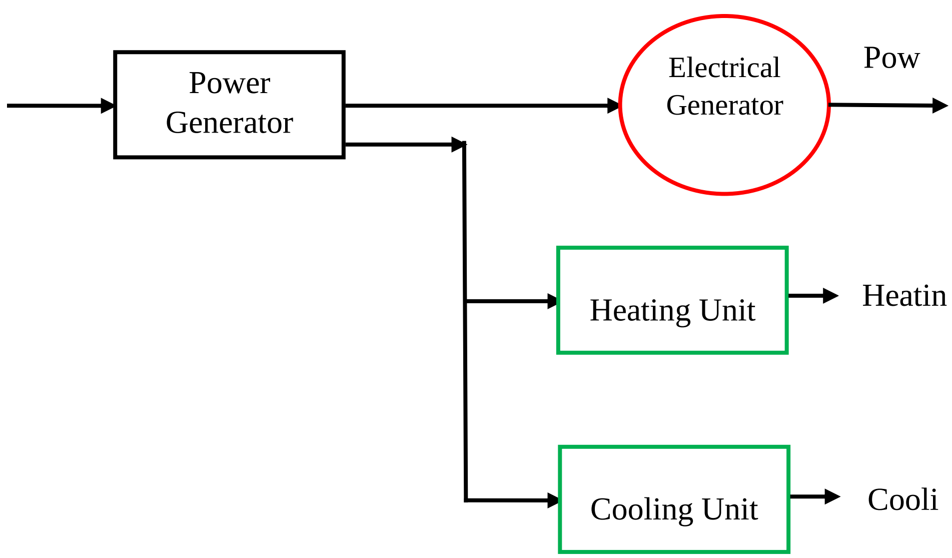


Figure 1: Proposed Process of CCHP

Thermal characteristics of heating network represent two features that is temperature loss and transmission delay concerning to pipelines. Between inlet and outlet of a pipeline hot water of pipeline flows slowly as a result obviously temperature drops for time delay, which specifies that a part of thermal energy is stored in pipelines. In addition, water temperature reductions beside the pipeline for the reason that heat losses distressing to the pipeline caused from temperature difference between pipelines outside environments.

Transmission Delay

Water is speedily heated in heat sources and forced to heat loads over pipelines with a continuous flow rate. Therefore, there is a time delay between temperature drops at heating loads and heat sources. The transmission delay time of a pipeline can be expressed as

$$\tau_i = (1 + \frac{\rho C_i L_i}{m_i \Delta t}) \frac{L_i}{u_i} \quad (1)$$

Where, iis an index of pipelines and 'τ I' defined as a transmission delay time pertaining to pipeline i (s), 'ρ' is a hot water density (kg/m3), 'Ci' refers is a cross-sectional area of pipeline i (m2), Li represent is a length of pipeline i (m), ui is a flow rate of hot water in pipeline i (m/s), 'mi' is a flow of water in pipeline i (kg/s), Δt is the length of time intermission in the dispatch.

Temperature Loss

Along the pipeline water temperature decreases because of heat losses belong to to the pipeline caused from temperature difference between pipelinesambient and outside environments. For pipeline i, and temperature loss of hot water can be expressed as p

$$\Delta T_{L,i}(t) = (1 - f^{\frac{\lambda\lambda_i}{E_p m_i}})(T_{h,i}(t) - T_o) \quad (2)$$

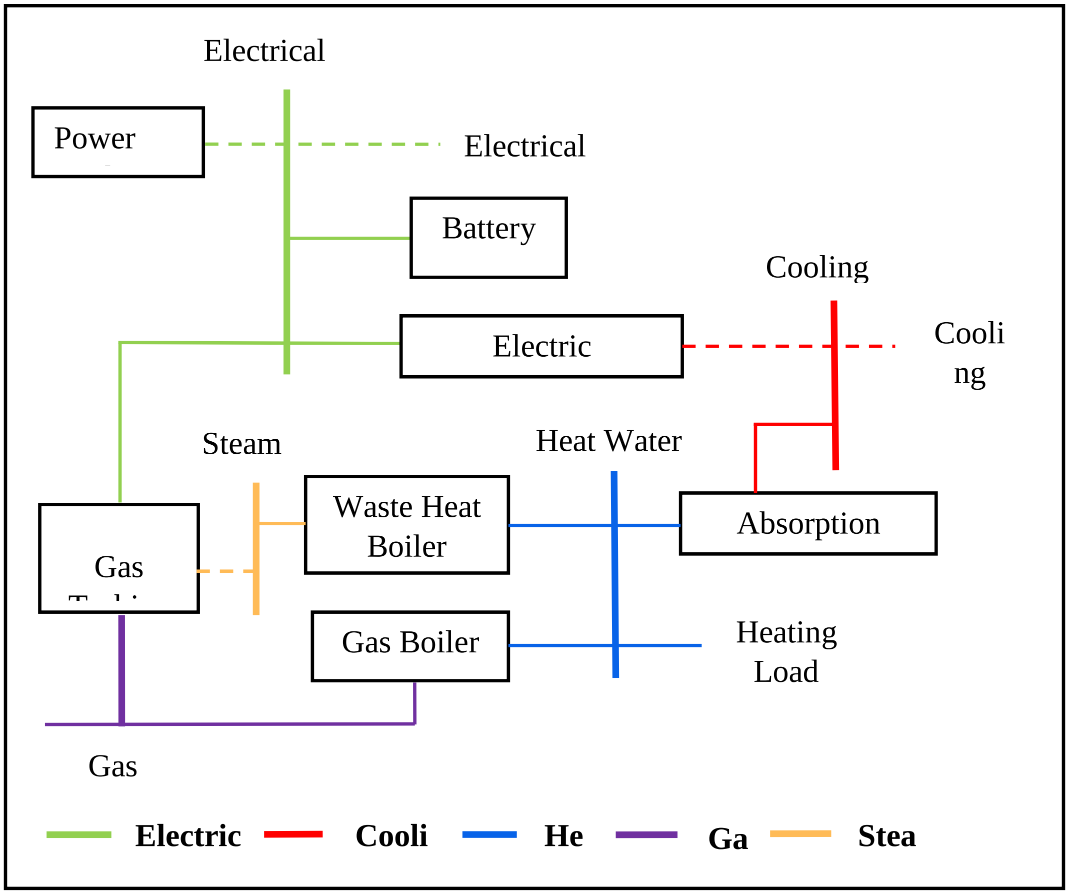
Where, ΔTL,i is the temperature drop of pipeline i at time t, Cp is a specific heat of water,Ts,i (t) is a temperature at the inlet of pipeline i at time t,is an complete heat transfer coefficient of every pipe per unit length (W/m), To is an ambient temperature. The transmission delay and temperature loss concerning to heating pipeline i can be developed by (1) and (2), as shown in

$$T_{p,i}(t + \tau_i) = (T_{h,i}(t) - \Delta T_{L,i}(t) \quad (3)$$

Where, Te,i (t+τ i) is a temperature at outlet of pipeline i at time t.The dispatch of optimal solution for transmission delay and temperature loss are defined through the CCHP of pipeline process by the bus schema of heat, cooling, electricity, steam and gas process are investigated in the proposed research.

III DISPATCH OPTIMIZATION MODEL OF CCHP MICROGRID

The optimization of the CCHP microgrid is demonstrated in Figure 2, which can meet difficulties of electricity, heat and cooling simultaneously. As shown in Figure 2, the electric and heat sources include gas boiler (GB) and gas turbine (GT) the energy storage devices essentially involves battery, and the energy transformation devices consist of electric refrigerator (ER), absorption chiller (AC) and waste heat boiler (WHB).



HEATING CHARACTERISTICS CONSTRAINTS

a) Transmission delay and temperature drop constraints of pipeline:

An optimal planning method for electrical thermal combined energy system considering heat storage characteristics of heating network is proposed in this research. Therefore, dynamic model of heat transmission considering time delay of heating network is proposed. The storage probable of heating network is analyzed.

The limitations on transmission delay and temperature loss connect to pipeline it can be developed by the expression of (1), (2) and (3), which will not be included here repeatedly for the equation.

b) Temperature constraints of pipeline:

In transmission of hot water, too high temperature causes two much heat degeneracy of pipelines and thus includescommercial performances. On the different too low temperature reduces heating quality of consumers.

As a result, the temperature of the hot water should be bounded in a reasonable range. Due to temperature loss, the inlet temperature at the supply pipeline of heat source is the highest of the entire heating network, while the outlet temperature at the return pipeline of the heat source is the lowest. Therefore, the constraints on temperature of hot water can be

$$\begin{cases} Tsg, I, t \leq T_{g\max} \\ \mathbf{Tsg, I, t,} \geq T_{h\min} \end{cases} \quad (4)$$

Where, max T_g is represented a maximum temperature of pipeline supply, $T_h$is a return pipelineof minimum temperature.

Combined with the energy equipment model an optimal scheduling process for electrical thermal integrated energy system considering heat storage features of heating network is proposed.The heating network is used as the planning resource to participate in the optimal scheduling of electrical thermal combined energy system.

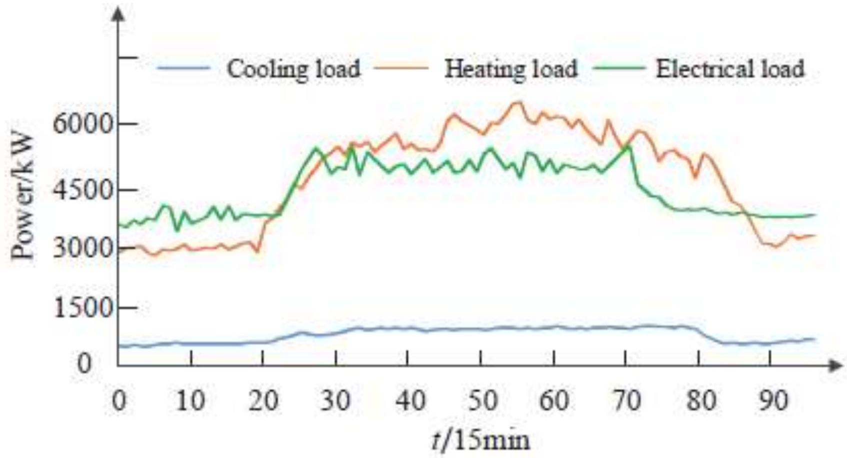


Figure 3: Predicted demands in the event of CCHP microgrid.

Numerical studies established that the model considering time delay and heat storage is able to reduce operational cost of integrated energy system, and take advantage of the complementarity between electrical and thermal power flow.

IV RESULT AND DISCUSSION

The predicted demands event of CCHP microgrid are respectively demonstrated in the below figure. Time used for process of tariff is proved in Below figures and unit calorific value of gas is 0.381 (¥/(kw·h)) are processed in the electric power of optimal dispatch.

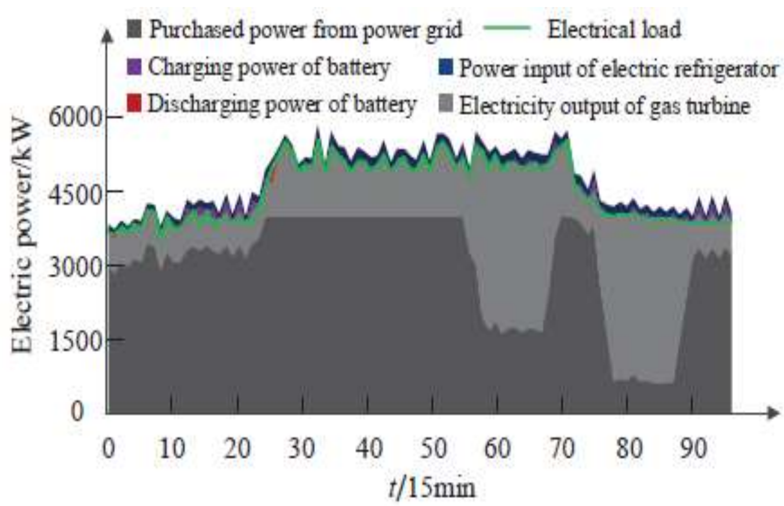


Figure 4: Optimal dispatch results of the electric power.

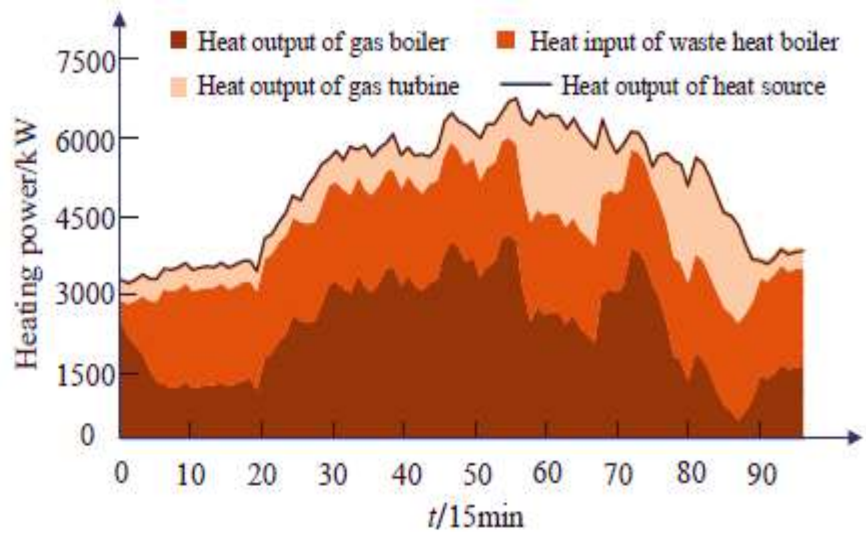


Figure 5: Optimal dispatch results of heat.

Total thermal energy introduced into heating networks during the dispatching day by all that consumed by all heat loads and heat sources are respectively illustrated in Figure 6. It can be establish that total energy production and also consumption are not equal for the period of the dispatching day for heating network has the character of heat storage bring about from transmission delay concerning to pipelines.

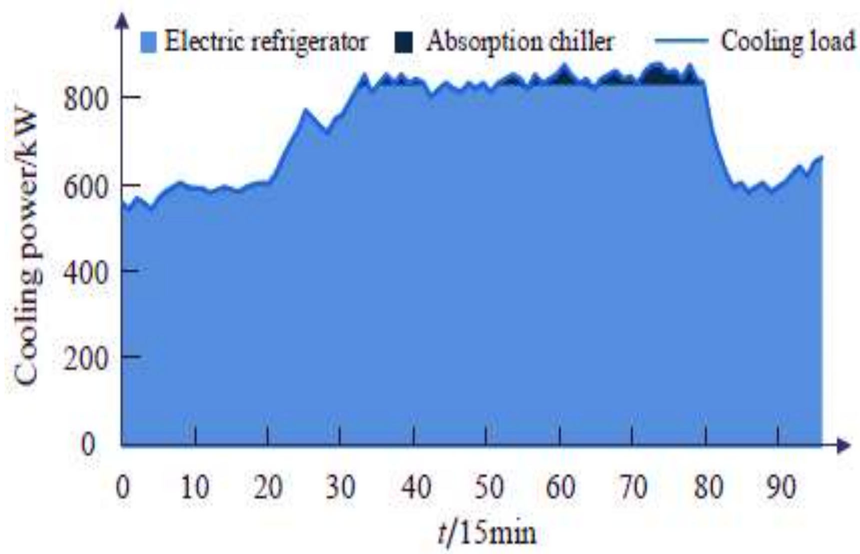


Figure 6: Optimal dispatch results of cooling.

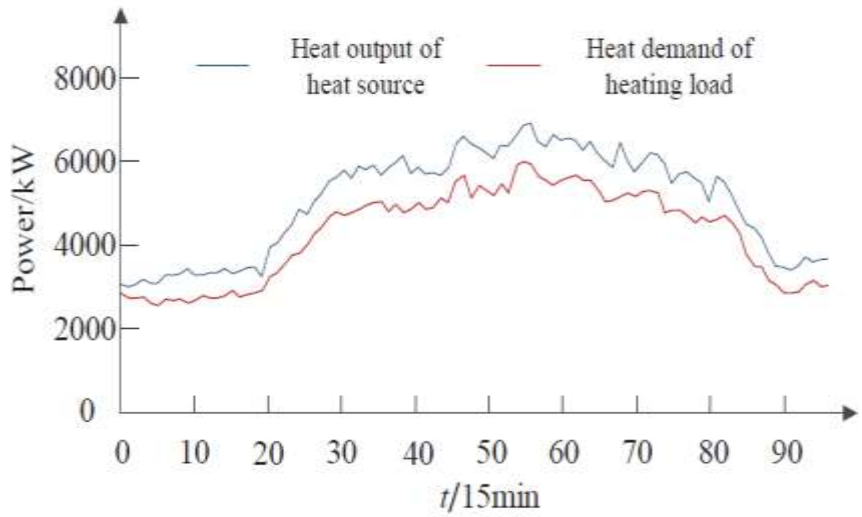


Figure 7: Heat outputs of all heat sources and heat demands of all loads

In addition, total energy consumption is obviously less than total energy construction. For the event CCHP microgrid heating network can be observed as heat storage method, which can release energy or store for succeeding better performance on economy.

Daily Operation Cost

By both with and without considering thermal characteristics of heating networkare calculated daily operation costs of the event CCHP microgrid are demonstrated in Table I, which are respectively noted as Event 1 and Event 2.

SCENES	**DAILY OPERATION COST (¥)**	**TIME OF CALCULATING**
Event 1	135720	0.03
Event 2	124500	0.05

TABLE 1: OPERATIONAL ECONOMIC COMPARISON

In event 1, the thermal characteristics of heating network are not measured and appropriately daily operation cost is ¥135720. However, the daily operation cost decreases from ¥135910 to ¥124500 with a reduction of ¥11630 when the thermal characteristics of heating network are included into the optimization model.The comparison described above demonstrates that the proposed model can deliver more economic dispatching solution because it can take the thermal characteristics of heating network into account.

V CONCLUSION

The research concluding, optimization model of CCHP microgrid is developed under the consideration of transmission loss a temperature delay are concerning to pipelines. Therefore, the dispatching optimization model can entirely exploit the capacity of heating network, changing rapidly the profile of heat load and deliver more practical and economical concern of thermal storage process of dispatching solution are used to analyze the delay and loss process. Simulation results can offer a theoretical support of optimization model of CCHP microgrid. However, the proposed module of thermal feature of heating network while dispatch the time interval of variation changes the error of limitation calculated.

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