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STUDY ON OPTIMIZING THE OPERATOIN OF HEAT SOURCE EQUIPMENTS IN AN ACTUAL HEATING/COOLING PLANT USING SIMULATION

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ABSTRACT

In order to determine the optimal combination of the heating source equipments in an existing office building, simulations of six different combination cases were conducted using the newly developed mathematical models of each component. From the simulation results, the optimal combination case can reduce the energy consumption by 19.7%, running cost by 12.8% and carbon-dioxide emissions by 29.6%, compared to the present operational combination.

KEYWORDS

Simulation, Commissioning, Energy Consumption, Running Cost, Carbon-dioxide Emissions

INTRODUCTION

In recent years, environmental issues, including global warming, energy conservation and reducing Carbon-dioxide (CO_2) emissions, are increasingly causing more attentions of all over the world. These issues are important in the field of building equipments industry as well. Buildings occupied by different types of tenant, whose work schedules might differ from each other, are equipped with multiple heat source equipments having different performance to satisfy different requirements, from large heating/cooling loads to small ones.

To satisfy heating/cooling requirements, achieve energy conservation and ensure cost efficiency, it is important to study the combination and operation priority order of the heat source equipments and find out the optimal operation method.

Therefore this research focuses on studying the central heating/cooling plant of an office building located in Osaka Japan to find an optimal operational combination of the heat source equipments. In detail, the following studies are conducted. 1) Develops mathematical models of each equipment in the heat source system using the specification data and refining the model using the data measured by the Building Energy Management System (BEMS). 2) Connects all component models to construct the whole system model of the plant. 3) Uses the system model to simulate the energy consumption, running cost and carbon-dioxide emissions of several different combinations of heat source equipments to find an optimal operational combination.

PROFILE OF THE PLANT

The plant has been in use since December 2004. It consists of two gas-fired absorption chiller/heaters, two air source heat pumps, one centrifugal chiller and one

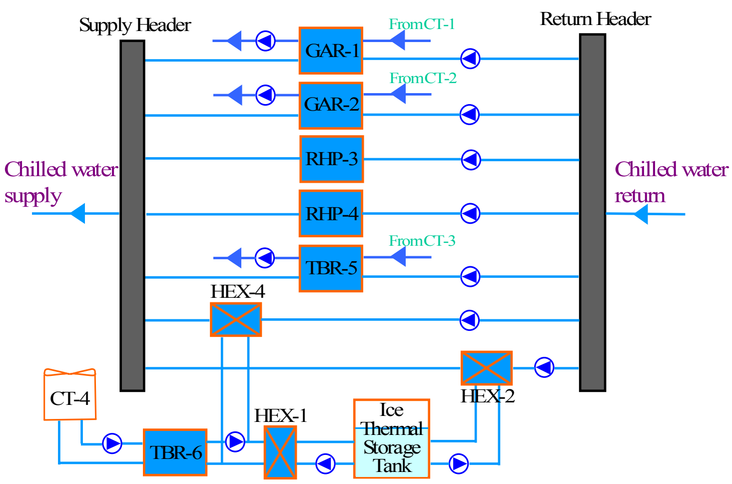

Figure 1 System diagram of the heat source system

Table 1 Heat sources list

Heat source	Name	Capacity[kW]	Number
Gas-fired absorption chiller/heater	GAR-1,2	1759	2
Air source heat pump	RHP-3,4	339	2
Centrifugal chiller	TBR-5	1406	1
Ice-making centrifugal chiller(ice making mode)	TBR-6	703.2	1
Ice-making centrifugal chiller(chilled water		879	

Table 2 Present operation priority

	Operation priority order	
	Daytime	Nighttime
1	thermal discharge	TBR-5
2	GAR-1	RHP-3
3	GAR-2	RHP-4
4	TBR-5	GAR-1
5	RHP-3	GAR-2
6	RHP-4	
7	TBR-6(chilled water mode)	※TBR-6(ice making mode)