"F-COOL NEO" Energy-Saving Hybrid Air-Conditioning Unit Indirectly Using Outside Air (Cooling Capacity 56 kW)

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In recent years, the amount of heat generated by servers used in data centers has increased dramatically due to their high performance and density. The heat generated by servers is generally cooled through the use of air conditioners. In order to save energy of the air conditioners and take advantage of natural energy, efforts are being made to adopt outside air cooling that utilize outside air as a cold heat source. Outside air cooling is classified as either direct system that directly use outside air or indirect system that use a heat exchanger to discharge heat to the outside air.

Fuji Electric has offered its "F-COOL NEO" hybrid air-conditioning unit (cooling capacity of 40 kW). It combines refrigeration cooling with indirect outside air cooling that is insusceptible to moisture, dust and corrosive substances. We newly developed a new model with a cooling capacity of 56 kW (see Fig. 1).

1. Features

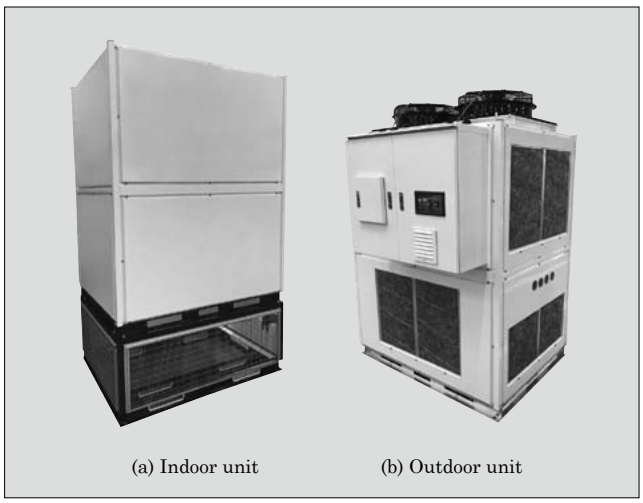
The main features of the F-COOL NEO are as follows:

(a) Yearly power consumption can be reduced to approximately one-third of that of general air conditioning systems due to the combined usage of indirect outside air cooling with refrigeration cooling.

(b) It is less susceptible to moisture, dust (such as PM2.5) and corrosive substances contained in outside air because it indirectly uses the air.

(c) Only the power supply is required. There is no need for cold water or cooling water.

(d) The supply air (blowing air) opening faces downward to accommodate installation on raised floors.



(a) Indoor unit (b) Outdoor unit

Fig.1 "F-COOL NEO" (cooling capacity 56 kW)

2. Specifications

Table 1 shows the specifications for the F-COOL NEO. The supply air opening of the 56-kW type faces downward. The energy consumption efficiency (Tokyo annual average) is COP*1 = 10, which is equivalent to that of the 40-kW type.

Table 1 "F-COOL NEO" specifications

Item		Specifications	
		FCA-56 A	FCA-40 A (conventional product)
Cooling method		Indirect outside air cooling (antifreeze) + compression refrigeration cooling (R410A)	
Specification voltage (V) (option indicated in parentheses)		400 (200)	200 (400)
Rated cooling capacity (kW)*		56	40
Maximum power consumption (kW)		26	16
Rated supply airflow (m^3/h)		12,000 Setting range: 2,500 to 16,800	8,500 Setting range: 2,500 to 12,000
Outside air intake temperature range (°C)		−15 to +43	
Supply air temperature setting (°C)		18 to 35	
Supply air direction		Downward	Lateral direction
Dimensions (excluding electric panel)	Indoor unit (mm)	W1,180 × D1,591 × H2,650	W1,180 × D1,158 × H2,300
	Outdoor unit (mm)	W1,180 × D1,591 × H2,288	W1,180 × D1,000 × H2,700
COP 26 °C supply air at rated supply airflow (Tokyo annual average)		10	

*At above 35 °C, the cooling capacity drops below the rating

*1: COP (coefficient of performance): Cooling capacity (kW) / Cooling power consumption (kW)

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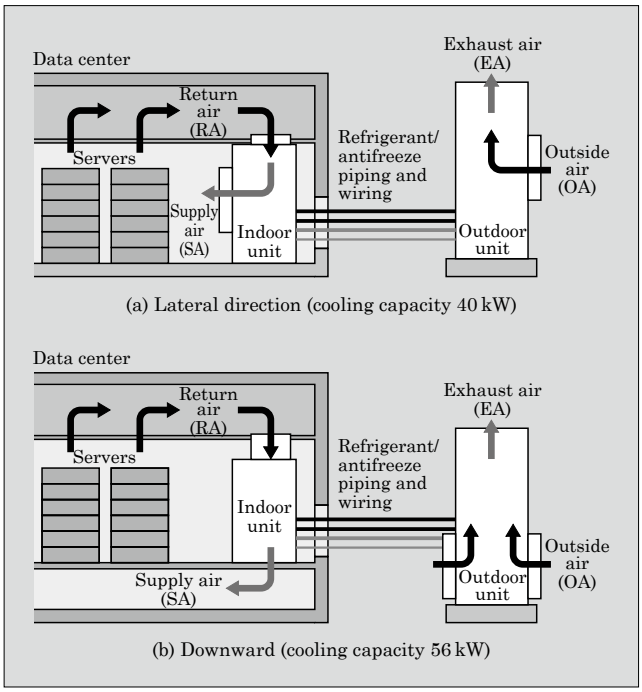

Fig.2 "F-COOL NEO" application examples

3. Application Examples

Figure 2 shows examples of applying the F-COOL NEO to a data center.

In order to cool the data center, cool air is supplied in the lateral direction from the indoor unit with server racks installed on the floor [see Fig. 2(a)], or supplied from underneath the floor with server racks installed on a raised floor [see Fig. 2(b)]. The former has the benefit of suppressing construction costs, while the latter has the advantage of providing uniform cooling over a wide floor space. The choice of systems often depends on the size of the data center and the performance of the installed servers.

Our recently developed type, delivering a large cooling capacity of 56 kW, has the supply air opening facing downward so that it will be used on raised floors of relatively large data centers.

4. Supporting Technologies

This section describes the operation control method for achieving energy savings in the F-COOL NEO. The control method is basically the same for both the 40-kW type and 56-kW type.

Indirect outside air cooling is highly efficient because it does not use a compressor. However, cooling capacity decreases as outside air temperature increases. A refrigerator is used to compensate for any insufficiencies in the cooling capacity of the indirect outside air cooling system. In order to achieve energy savings by reducing the operation of the compressor as much as possible, the system maximizes the use of

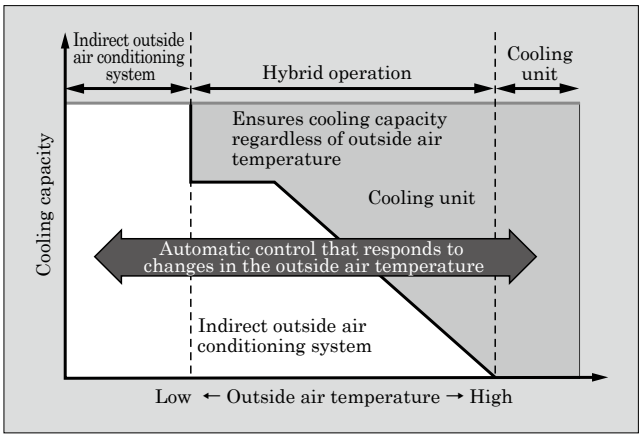

Fig.3 Schematic representation of the capacity sharing between the indirect outside air cooling and refrigeration cooling

outside air cooling by automatically selecting the appropriate mode from among several operating modes.

Figure 3 shows the schematic representation of the capacity sharing between the indirect outside air cooling and refrigeration cooling. It shows the ratio of capacity sharing between indirect outside air cooling and refrigeration cooling by plotting the outside air temperature on the abscissa and the cooling capacity on the ordinate. In order to maintain cooling capacity regardless of the outside temperature, operation is primarily carried out by the following 3 modes:

(1) Indirect outside air cooling independent operation (indirect outside air cooling mode)

The indirect outside air cooling system runs independently when the capacity of the indirect outside air cooling is sufficient for the cooling load.

(2) Combined use of indirect outside air cooling and refrigeration cooling (hybrid operation mode)

The refrigerator is used to compensate for any insufficiencies when the cooling capacity of the indirect outside air cooling system falls below the cooling load. However, its usage must be minimized because running the compressor will lower overall efficiency.

(3) Refrigerator independent operation (refrigeration cooling mode)

The refrigerator is used independently when the outside air cooling capacity is ineffective due to the outside air temperature exceeding the return air temperature.

Figure 4 shows the schematic representation of the operation of major equipment at each F-COOL NEO cooling mode. As mentioned above, the F-COOL NEO consists of 2 cooling systems, namely, an indirect outside air cooling system and a refrigeration cooling system. The indirect outside air cooling mode only uses a pump and fan to cool the air [see Fig. 4(a)]. The hybrid operation mode simultaneously operates refrigeration cooling, which uses the compressor and expansion valve, along with indirect outside air cooling [see Fig. 4(b)]. The refrigeration cooling mode operate refrigera-

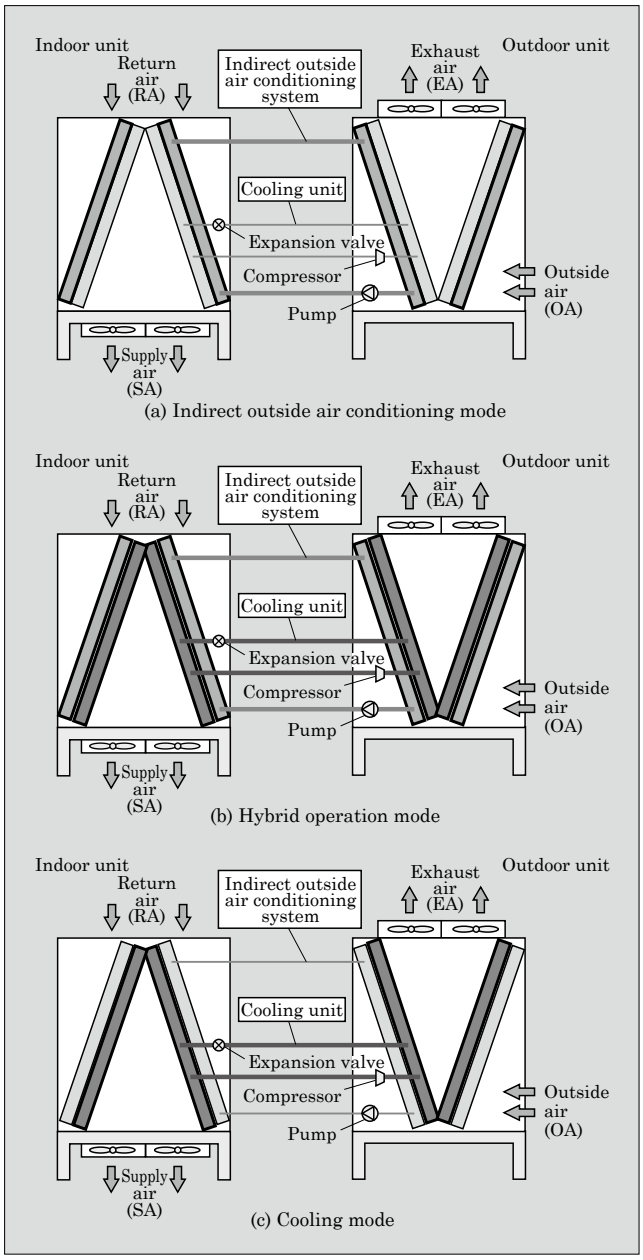

Fig.4 Operation of major equipment at each cooling mode

tion cooling, which uses the compressor and expansion valve instead of the pump [see Fig. 4(c)].

The 56-kW type needs a larger heat exchanger to achieve a cooling capacity beyond that of conventional units, while also maintaining energy saving performance. Although the heat exchanger for the 40-kW type was installed upright, the same configuration in the 56-kW type would have led to an increase in equipment dimensions. Therefore, the heat exchanger in the 56-kW type is segmented and installed at an angle to resolve the issue.

Launch time

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Product inquiries

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