MITSUBISHI
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Changes for the Better

For Internal Training

Water System

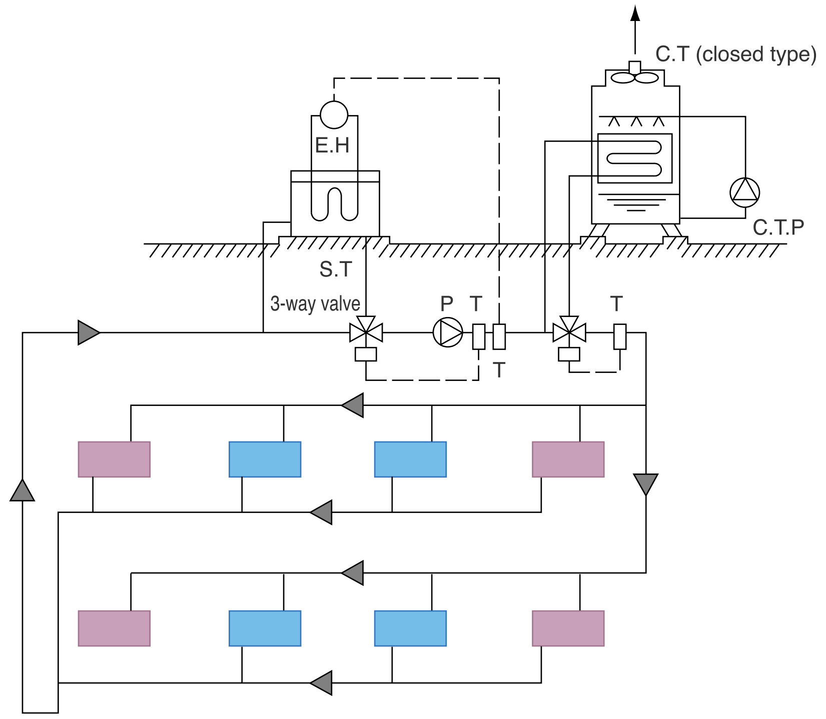
CITY MULTI *WR2*
CITY MULTI *WY*

Sales / Technical Guide

Example of a Basic Water Circuit

As shown in the example below, the water circuit for the WR2 / WY series consists of heat source units connected by a single water piping system to a cooling tower, an auxiliary heat source, a thermal storage tank, and a circulating pump. The circuit adjusts automatically using switching valves to circulate the water to the cooling tower during cooling periods or to the thermal storage tank during heating periods. Both the cooling and heating operations of the WR2 / WY series will function, regardless of the building's load, if the temperature of the circulating water is kept in the range of 10-45°C. In summer, when the only load is cooling, the cooling tower operates and controls the temperature increase of the circulating water. In winter, when the heating load is large, there is a possibility of the circulating water temperature dropping below 10°C; therefore, if it drops below a set temperature, additional heat is supplied by the auxiliary heat source.
When the heat flux of the cooling and heating operations is balanced, operation of the auxiliary heat source or the cooling tower is not necessary.
It is economical to make use of a thermal storage tank to regulate the heat flux balance mentioned above for effective use of heat energy and to use nighttime power for the auxiliary heat source.
This system uses many heat source units with heat exchangers built in on the water side, so water quality control is important. Therefore, a closed-type cooling tower must be used to prevent contamination of the circulating water.

Example of a basic water circuit for water heat source unit "City Multi"



Indoor units and refrigerant piping system are omitted.

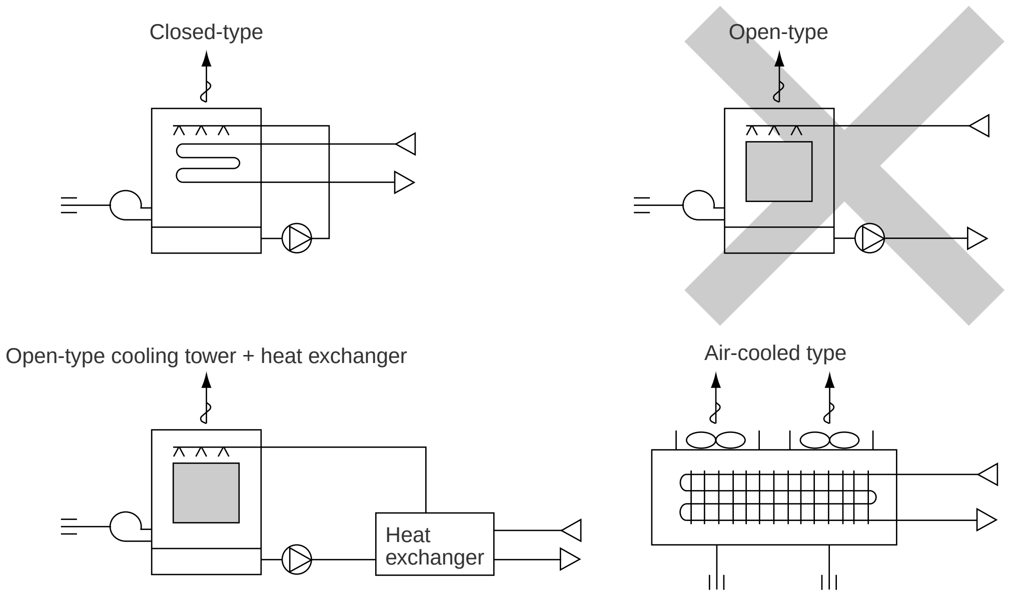
S.T : Heating tank (thermal storage tank)
C.T : Cooling tower
C.T.P : Cooling water pump
P : Water circulating pump
T : Thermostat for water
E.H : Heater for heating tank
🟦 : Cooling unit
🟪 : Heating unit

Cooling Tower

Types of Cooling Tower

Types of cooling tower include open-type, open-type + heat exchanger, closed-type, and air-cooled. However, because the units are scattered within the building and quality control of the circulating water is important, a closed-type cooling tower must be used with the WR2 / WY series.
If a closed-type cooling tower is used, the circulating water will not become contaminated by the atmosphere. However, blow down of the water in the system and supplementation with fresh water should be carried out periodically.
Also, in districts where coils may freeze during the winter, it is necessary to consider freezing prevention measures that automatically remove water from the cooling coil when the pump stops.

Types of cooling tower



Method for Calculating Cooling Tower Capacity

In summer, all the water heat source units may temporarily (at start up) operate in cooling mode. However, because the operating water temperature range of the WR2 / WY series is wide (10℃-45℃), it is not necessary to determine the cooling tower capacity by the total cooling capacity of all heat source units. It is determined by the sum of the building's actual peak cooling load, the heat input equivalent of all heat source units and the cooling loads of the circulating pumps, etc. The values of cooling water volume and circulating water volume must also be checked.

$$\text{Cooling tower capacity} = \frac{860 \times Qc + 860 \times (\Sigma Qw+Pw)}{3{,}900} \quad \text{(Cooling tons)}$$

Qc: Actual peak cooling load (kW)
Qw: Total input of heat source units during peak simultaneous operation (kW)
Pw: Shaft power of circulating pumps, etc. (kW)

Auxiliary Heat Source and Heat Storage Tank

With the heat balance of the system, when the heating load is greater than the cooling load, the temperature of the circulating water will drop. Therefore, in order to maintain the water temperature at the entrance within the operating range of the WR2 / WY series (above 10°C), heat must be added using an auxiliary heat source.

In addition, it is possible to operate the heat source units more effectively by taking into account morning start-up loads, heat deficiencies, etc., and utilizing a thermal storage tank.

In other words, effective heat use can be achieved by installing a thermal storage tank and storing surplus heat or storing heat when the heat source units are stopped or when using a low load auxiliary heat source to cover the warming-up period on the following morning or at peak load times.

In addition, by using nighttime power to store heat, operation costs can be reduced. Therefore, we recommend that both an auxiliary heat source and a thermal storage tank to be utilized.

In a conventional thermal storage tank, even if heat is stored at 45°C, the effective temperature differential is around 5K. However, the WR2 / WY series can be used as heat sources for heating until 10°C and the effective temperature differential is large, at around 30K, so the capacity of the thermal storage tank itself can be small.

Auxiliary heat source

The following can be considered as auxiliary heat sources:

- Boiler (heavy oil, kerosene, gas, electricity)
- Electric heat (insertion of electrothermic equipment into thermal storage tank)
- Outdoor air (air-source heat pump chiller)
- Thermal discharge (wastewater heat from machinery inside building and hot water supply)
- Utilization of nighttime electricity
- Solar heat
- Ground heat

However, the operating environment and cost effectiveness should be taken into account when choosing the auxiliary heat source.

Method for determining auxiliary heat source capacity

The use of a thermal storage tank with the WR2 / WY series is advised. However, in cases where it is unavoidably difficult to add a thermal storage tank, the start-up heating load should be handled using the warming-up operation.

The water retained in the piping circuit has a heat capacity and, except for in cold districts, the warming-up operation for the WR2 / WY series will take approximately 1hr. The thermal storage tank’s capacity must be selected on the basis of the daily peak heating load, including the warming-up operation on the day after a holiday, etc. However, the auxiliary heat source capacity is determined by the daily heating load, taking into account weekday start-up.

With regard to the load on the day after a holiday, the auxiliary heat source will operate overtime to store heat.

When Heat Storage Tank is Not Used

$$Q_H = HC_T\left(1-\frac{1}{COP_H}\right)-\left(\frac{1000\times V_W\times \triangle T}{860}\right)-P_W$$

Q_H : Auxiliary heat source capacity (kW)
HC_T : Total heating capacity for each WR2 / WY series unit (kW)
COP_H : Coefficient of performance for WR2 / WY series units during heating
V_W : Water volume retained in piping (m^3)
$\triangle T$: Allowable water temperature drop =T WH - TWL (°C)
T_{WH} : Heat source water temperature on high temperature side (°C)
T_{WL} : Heat source water temperature on low temperature side (°C)
P_W : Heat source water pump shaft power (kW)

When Heat Storage Tank is Used

$$Q_H = \frac{HQ_{1T}\left(1-\frac{1}{COP_h}\right)-P_W\times T_2}{T_1}\times K \qquad (kW)$$

HQ_{1T} : Total weekday heating load taking start-up into account (kW)
T_1 : Operating time of auxiliary heat source (h)
T_2 : Operating time of heat source water pump (h)
K : Surplus factor (thermal storage tank, piping loss, etc.) 1.05 ~ 1.10

HQ_{1T} is approximated from steady load calculation results using the following equation.

$$HQ_{1T} = 1.15\times(\sum Q'a+\sum Q'b+\sum Q'c+\sum Q'd+\sum Q'f)\,T_2$$
$$-\ \psi\,(\sum Q'e_1+\sum Q'e_2+\sum Q'e_3)\,(T_2-1)$$

Q'a : Heat load from outside walls and roofs in each zone (kW)
Q'b : Heat load from glass windows in each zone (kW)
Q'c : Heat load from room partitions, ceilings, and floors in each zone (kW)
Q'd : Heat load due to drafts in each zone (kW)
Q'f : Fresh air load in each zone (kW)
$Q'e_1$: Heat load from human bodies in each zone (kW)
$Q'e_2$: Heat load from lighting equipment in each zone (kW)
$Q'e_3$: Heat load from machinery in each zone (kW)
ψ : Radiation load rate 0.6 ~ 0.8
T_2 : Air conditioning time

Heat Storage Tank

Thermal storage tanks can be broadly classified into two types according to their structure; open-type thermal storage tanks, which are open to the atmosphere, and closed-type thermal storage tanks, which are isolated from the atmosphere. Due to the problem of corrosion, the closed-type must be used.
The capacity of the thermal storage tank is determined by the daily peak heating load, including the warming-up load on the day after a holiday, etc.

When the auxiliary heat source is operated during and after WR2 / WY series operation.

$$V = \frac{HQ_{2T}\left(1 - \frac{1}{COPh}\right) - P_W \times T_2 - QH \times T_2}{\frac{\triangle T \times 1000 \times \eta V}{860}} \quad \text{(tons)}$$

When the auxiliary heat source is operated after stopping WR2 / WY series operation.

$$V = \frac{HQ_{2T}\left(1 - \frac{1}{COPh}\right) - P_W \times T_2}{\frac{\triangle T \times 1000 \times \eta V}{860}} \quad \text{(tons)}$$

HQ_{2T} : Peak heating load taking into account the load on the day after a holiday, etc. (kW)
$\triangle T$: Thermal storage tank temperature differential (K)
ηV : Thermal storage tank efficiency
HQ_{2T} : $1.3 \times (\Sigma Q'a + \Sigma Q'c + \Sigma Q'd + \Sigma Q'f)\, T_2 - \psi\, (\Sigma Q'e_2 + \Sigma Q'e_3)\,(T_2 - 1)$

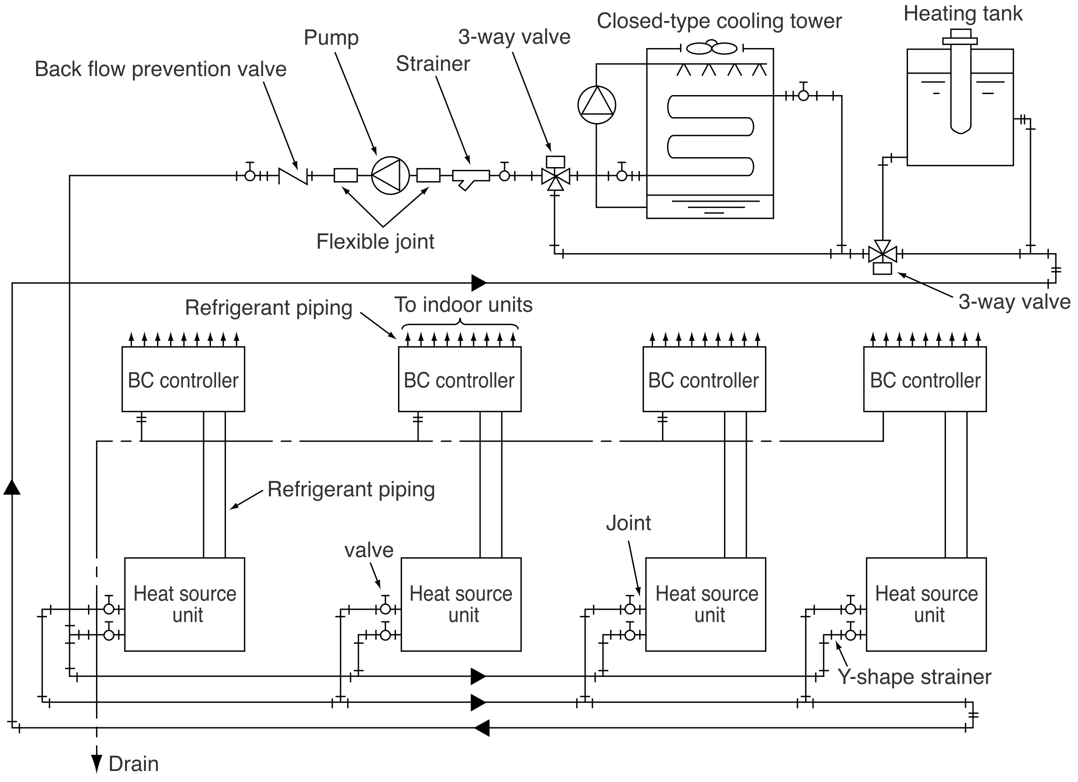
Piping System

The following points must be carefully considered during planning and designing of the water circuit.

(A) All the units are formed with one circuit.

(B) When arranging many WR2 / WY series units, the piping resistance to each unit must be roughly the same, and the standard circulating water volume must be maintained. One example is a reverse-return system, as shown in the diagram.

Example of a basic water circuit system



(C) The layout of the water circuit will depend on the structure of the building, but standardization and prefabrication can also be taken into account.

(D) If a closed piping circuit is constructed, an expansion tank combined with a make-up water tank must be installed to absorb expansion and contraction of the water due to temperature changes.

(E) If the temperature range of the circulating water is kept close to average throughout the year (summer 30°C, winter 20°C), it is not necessary to provide insulated or condensation proof piping inside the building.

However, insulation is necessary in the following cases.

- Well water is used as heat source water.
- The piping is laid outdoors or in other places where there is possibility of freezing.
- There is a possibility of condensation forming on the piping due to an increase in the wet-bulb temperature caused by the incursion of fresh air.

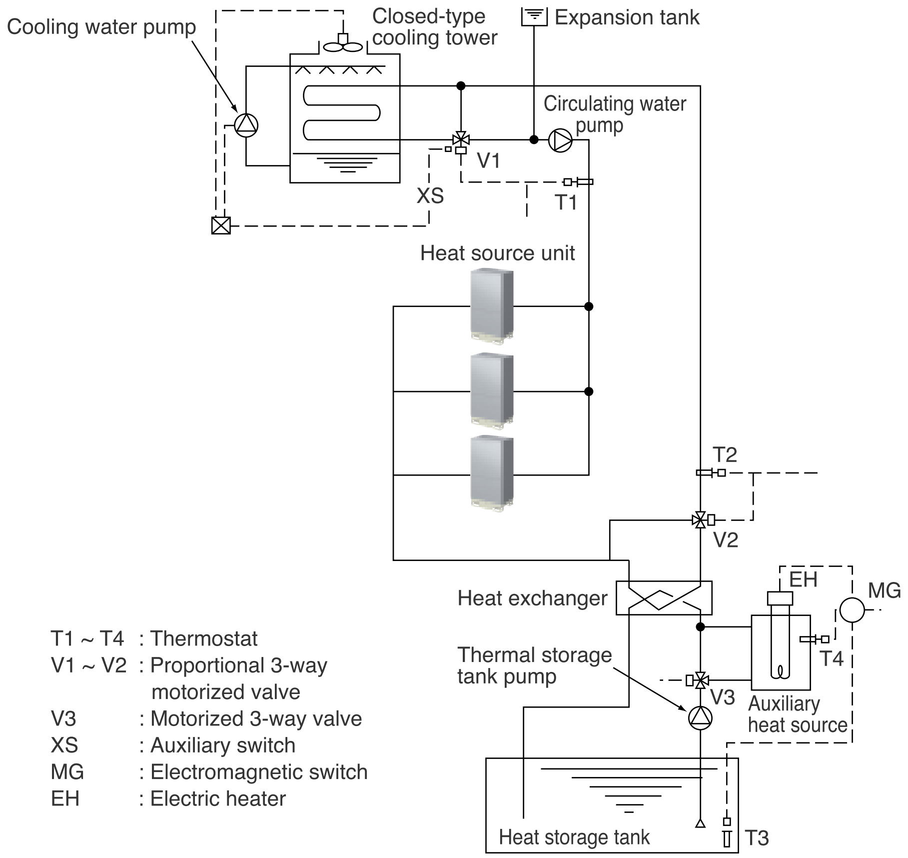
Examples of Actual Systems and Control of Circulating Water

Because the WR2 and WY series are water heat source units, various systems with a variety of heat sources can be constructed. Below are some examples of systems.

Both cooling and heating modes of the WR2 / WY series units will operate as long as the circulating water temperature is within the 10°C ~ 45°C range; however, taking into consideration the lifespan of the air conditioner, power consumption, performance, etc., the recommended circulating water temperature is approximately 30°C in cooling mode and approximately 20°C in heating mode. Details regarding how to control the temperature accordingly are described below.

Example 1

Closed-type cooling tower + hot water storage tank (using underground hollow slab) combination



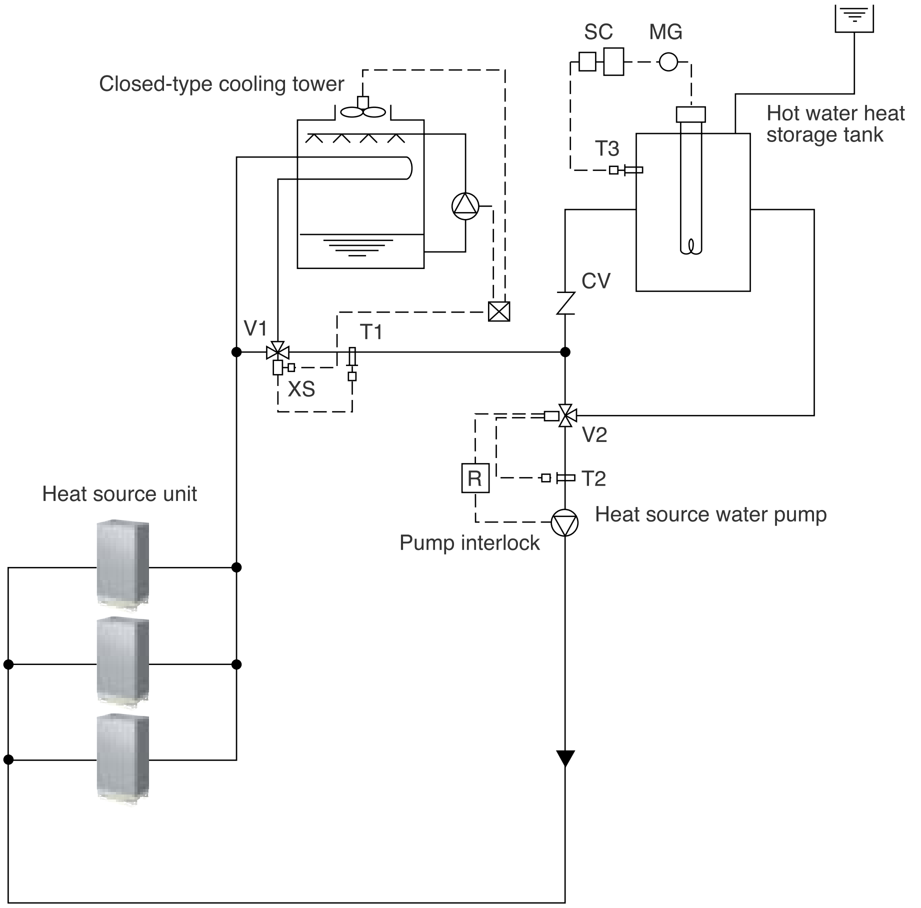
T1 ~ T4 : Thermostat
V1 ~ V2 : Proportional 3-way motorized valve
V3 : Motorized 3-way valve
XS : Auxiliary switch
MG : Electromagnetic switch
EH : Electric heater

The circulating water temperature for the WR2 / WY series is detected by T1 (approximately 30°C) in summer and T2 (approximately 20°C) in winter, and the valves, V1 in summer and V2 in winter, are opened or closed to control the temperature.

In summer, if the circulating water temperature rises above the set temperature of T1, the bypass port of V1 opens and the circulating water temperature drops. In winter, when the circulating water temperature falls, V2 opens on command from T2 and the circulating water temperature increases. During the night, V3 opens according to a timer and the auxiliary heat source heats the water in the thermal storage tank. The auxiliary heat source's electric heater is controlled by T3 and a timer. Starting and stopping of the closed-type cooling tower fan and pump is directed by V1's auxiliary switch, XS, and by controlling by stages. With this control, only the fan operates when load is light, and both the fan and the pump operation during peak load periods which achieves water temperature control and power savings.

Example 2

Closed-type cooling tower + hot water heat storage tank combination

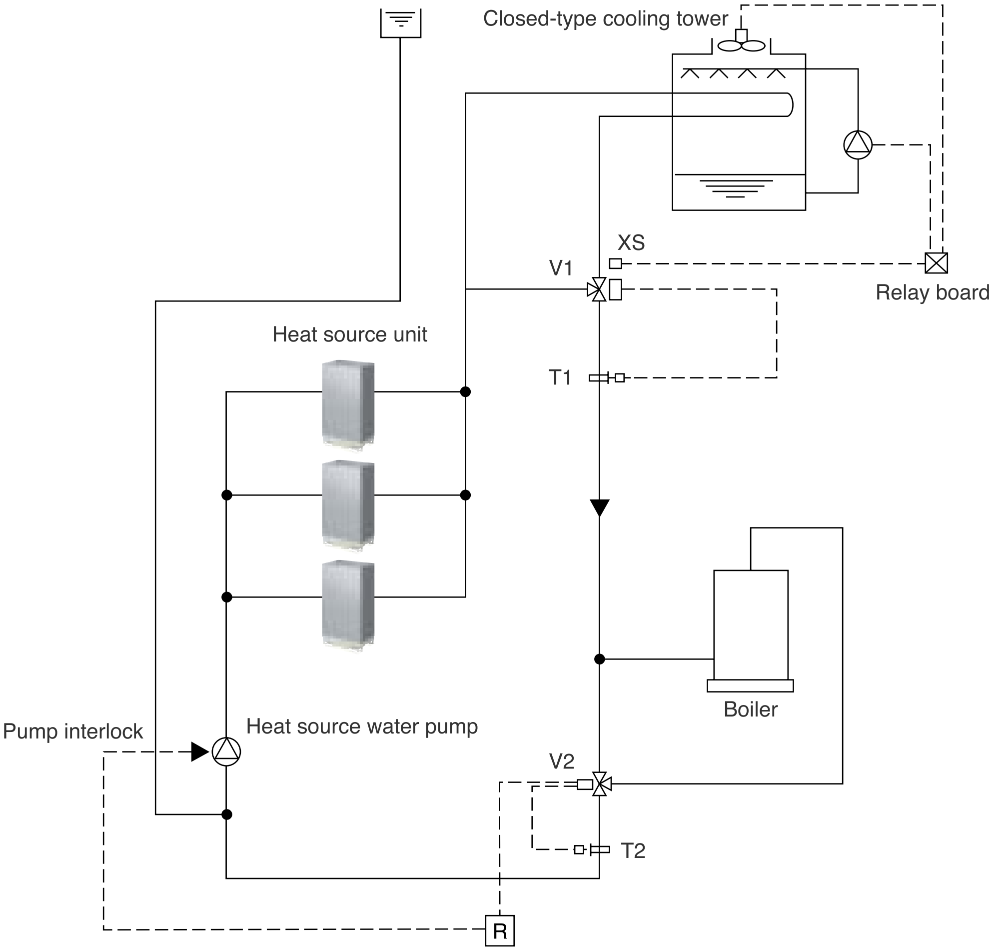


T1 : Proportional insertion-type temperature regulator
T2 : Proportional insertion-type temperature regulator
T3 : Proportional insertion-type temperature regulator
V1 : Proportional 3-way motorized valve
V2 : Proportional 3-way motorized valve
XS : Auxiliary switch (2 switch type)
SC : Step controller
R : Relay
MG : Electromagnetic switch

In summer, if the circulating water temperature rises above the set temperature of T1, V1's bypass port will open to lower the circulating water temperature. In winter, when the circulating water temperature is below 25°C, V2 will open or close on command from T2 to keep the circulating water temperature stable.
The water temperature inside the hot water heat storage tank is controlled via T3 which causes the step controller to move, thereby performing step control of the electric heater.
When the heat source water pump is stopped, the interlock causes V2's bypass port to close completely. This prevents the influx of high temperature water into the system on pump start up.
Starting and stopping of the closed-type cooling tower's fan and pump is directed by V1's auxiliary switch, XS, and step control of just the fan operation when load is light and both the fan and the pump operation during peak load periods achieves water temperature control and power savings.

Example 3

Closed-type cooling tower + boiler combination



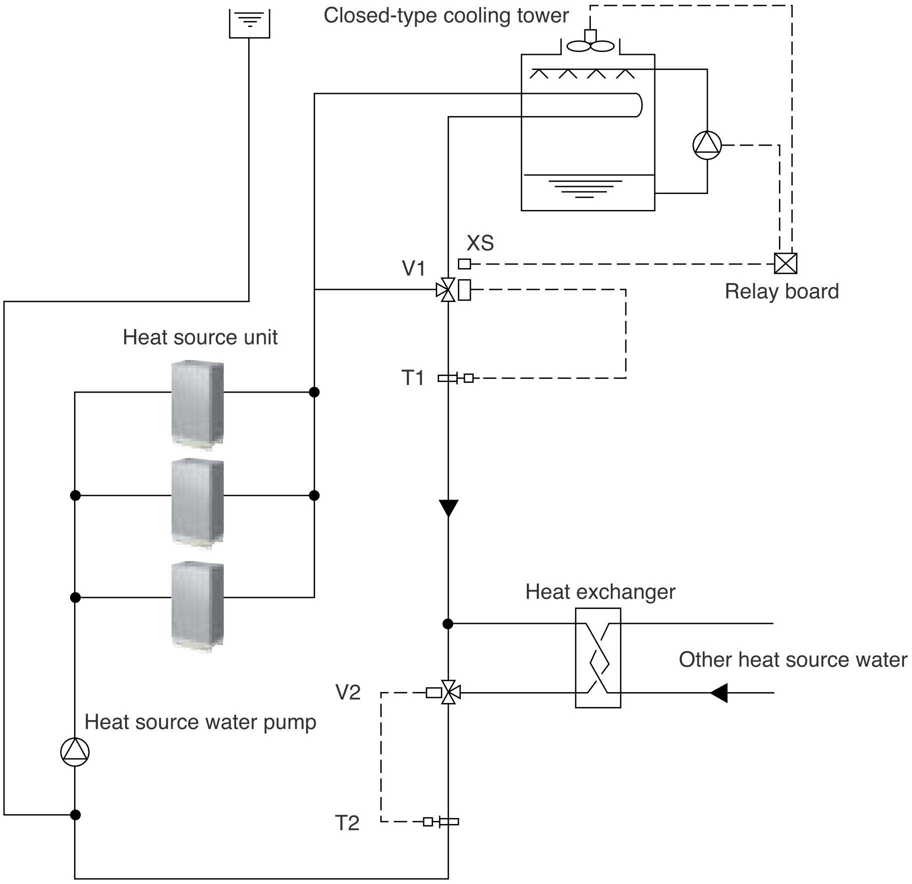
T1 : Proportional insertion-type temperature regulator
T2 : Proportional insertion-type temperature regulator
T3 : Proportional insertion-type temperature regulator
V1 : Proportional 3-way motorized valve
S : Changeover switch
R : Relay
XS : Auxiliary switch (2 switch type)

In summer, if the circulating water temperature rises above the set temperature of T1, V1's by-pass port will close to lower the circulating water temperature. In winter, when the circulating water temperature falls below 25°C, the water temperature will be controlled by V2 to keep the circulating water temperature stable. When the heat source water pump is stopped, the inter-lock causes V2's bypass port to close completely.

Starting and stopping of the closed-type cooling tower's fan and pump is directed by V1's auxiliary switch, XS, and step control achieves water temperature control and power savings.

Example 4

Closed-type cooling tower + heat exchanger (other heat source) combination

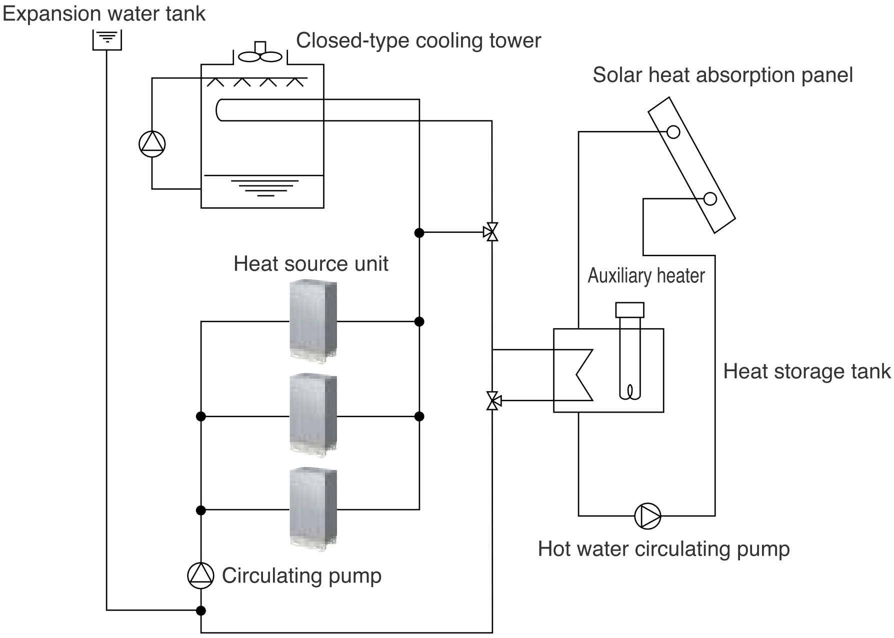


T1 : Proportional insertion-type temperature regulator
T2 : Proportional insertion-type temperature regulator
V1 : Proportional 3-way motorized valve
V2 : Proportional 3-way motorized valve
S : Changeover switch
R : Relay
XS : Auxiliary switch (2 switch type)

In summer, if the circulating water temperature rises above the set temperature of T1, V1's bypass port will close to lower the circulating water temperature. In winter, when the circulating water temperature falls below 26°C, the water temperature will be controlled by V2 to keep the circulating water temperature stable. When the heat source water pump is stopped, the interlock causes V2's bypass port to close completely.
Starting and stopping of the closed-type cooling tower's fan and pump is directed by V1's auxiliary switch, XS, and step control achieves water temperature control and power savings.

Example 5

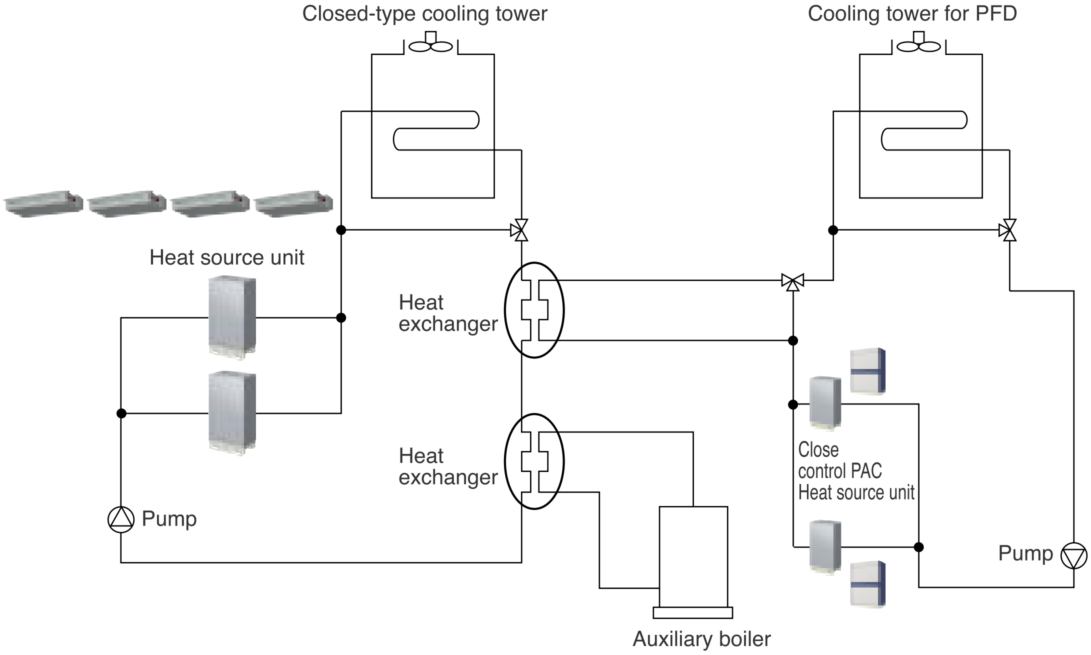
Use of solar heat



Solar heat is stored and used as an auxiliary heat source for the WR2 / WY series units. An auxiliary heater is also incorporated for periods of bad weather.

Example 6

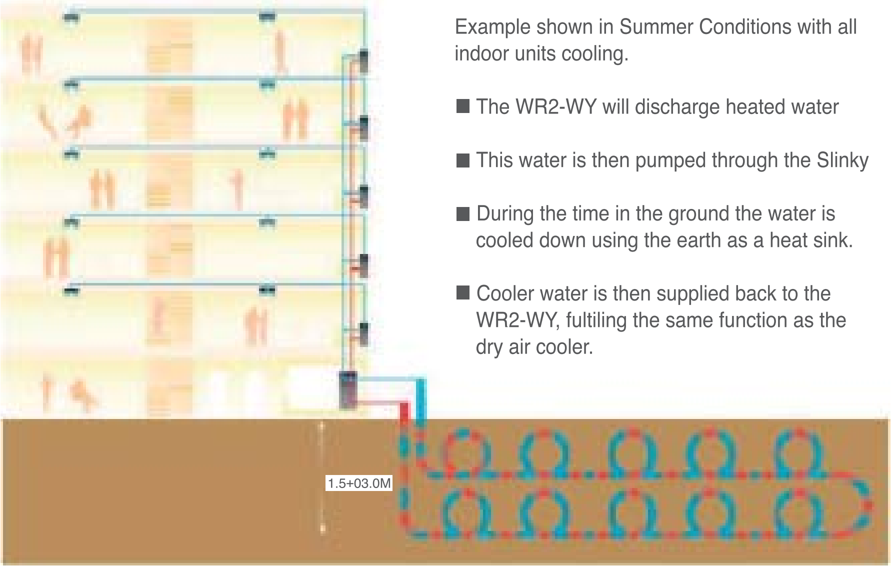
Combination with close control PAC (PFD series)



The close control PAC is in cooling mode throughout the year and in the winter, this surplus waste heat radiates from the cooling tower. By using this wasted heat as a heat source for the WR2 / WY series, boilers for offices other than the computer room may be reduced or even removed completely. In addition to this, the use of a heat storage tank can also be considered.

Example 7

Ground Heat Source by MEU-UK



Example shown in Summer Conditions with all indoor units cooling.

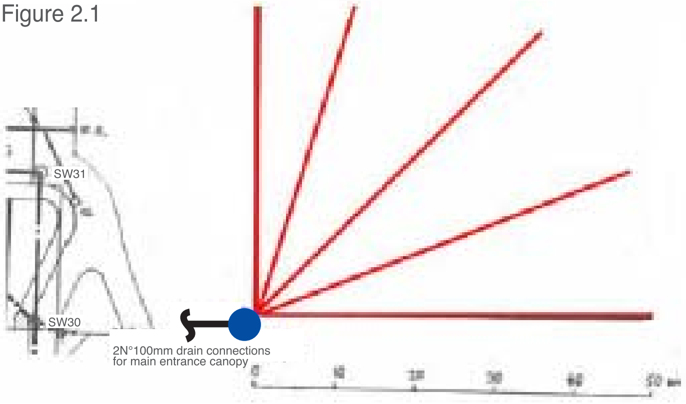
- The WR2-WY will discharge heated water
- This water is then pumped through the Slinky
- During the time in the ground the water is cooled down using the earth as a heat sink.
- Cooler water is then supplied back to the WR2-WY, fultiling the same function as the dry air cooler.

Installation.

The ground loop was designed according to the design from Geo-Science LTD utilising the vertical slinky method. The ground was dug from the building 1m deep to a central header 1.8m deep. From this header 5 separate trenches were dug; 0.3m wide and 1.8m deep. The trenches fan out as shown in figure 2.1. Plastic (Polyethylene) pipe is then laid vertically in the trenches with the bottom of the trench lined with 0.1m of sand. Following this the slinky was then covered with sand in order to achieve the maximum surface area to the ground and so give the best heat transfer.

Following this the remaining trench can be filled in with the soil dug from the trench.

Figure 2.1



KEY

🟥	50m long slinky. Installed in trench 1.8m deep by 300mm wide. Backfilled with sand around slinky as per our installation instructions
●	Manifold Pit-Supplied and installed by others
—	Flow and return trench to plant room 1m wide x 1.2m deep

Equipment Used for Monitoring and Logging

Temperature Measurement ; 2 X K-Type Thermo Couple
Power Consumption ; EL Time Controls E-Series kW Transducer
Monitoring and Logging ; Mitsubishi Electric Q Series PLC + E1100 HMI.

UK Conditions : Summer : indoor 21°CDB, 15°CWB ; outdoor 27°CDB
Winter : indoor 21°CDB ; outdoor -1°CWB

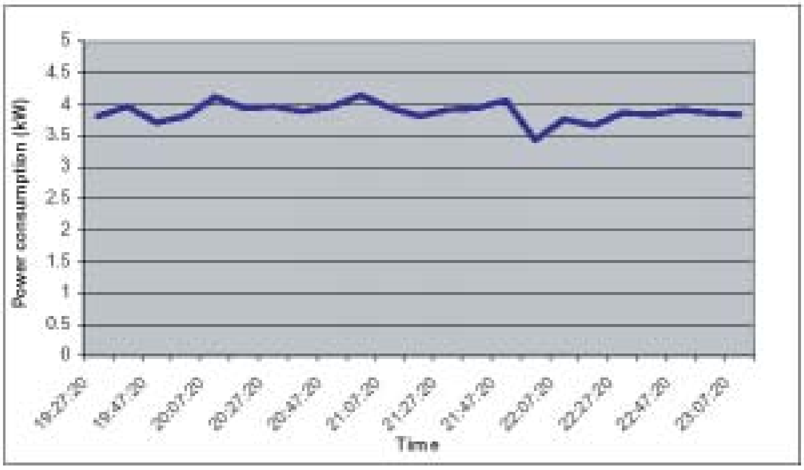
Cooling Analysis.

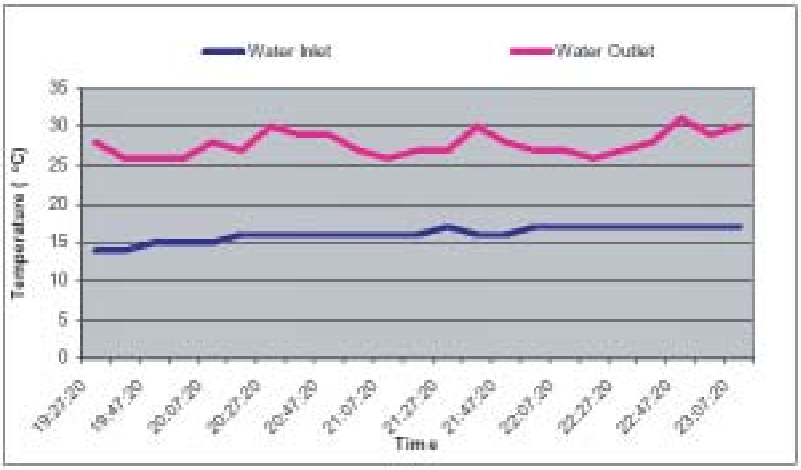
100% Operation.

% Loading	Water Temperature	Cooling Capacity	Average Power Consumption	Average COP
100	16.09	16	3.87	4.13

The data shows that the compressor power consumption was stable at an average of 3.87kW, proving that the cooling load on the system was constant. The water Temperature started at 14°C and raised up to a maximum temperature of 17°C.The ground temperature remains a fairly constant 10 Degrees during the 4-hour test. This shows that the ground was very effective at cooling the water loop, as the heat rejection into the ground was 23kW for 4 hours, the equivalent of 92kWhs of free cooling from the ground.

To summarise, for every kW of electricity that the system consumes at 100% load, 4.13kW of Cooling was produced.



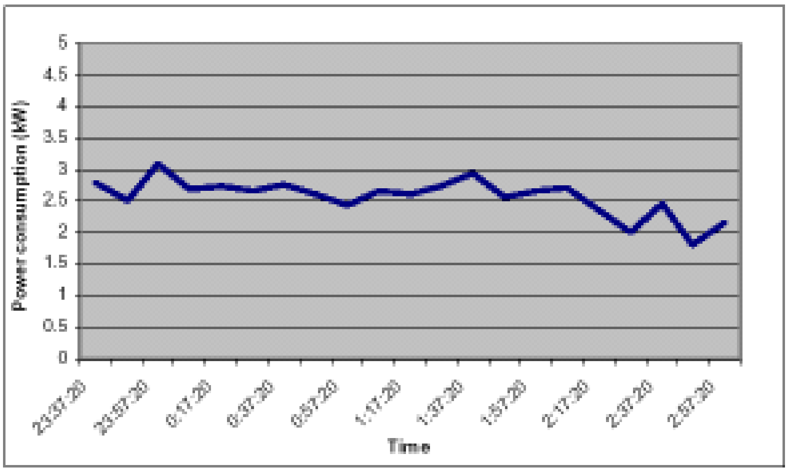


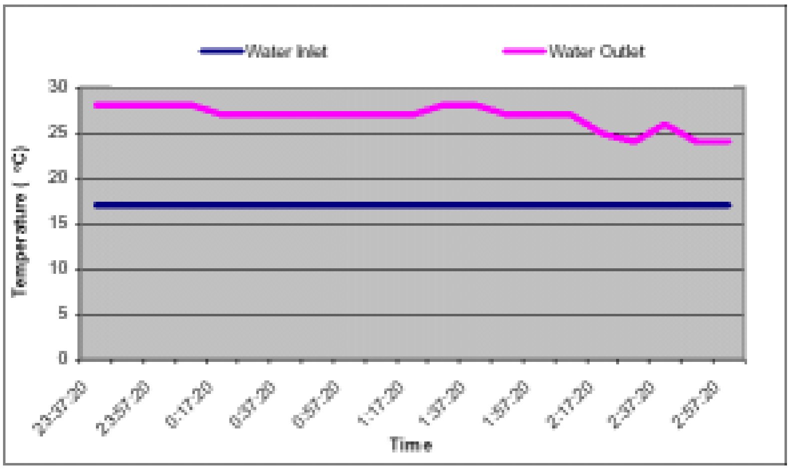
75%Operation.

% Loading	Water Temperature	Cooling Capacity	Average Power Consumption	Average COP
75	17.00	12	2.57	4.67

This test directly followed the 100% cooling test, thus the water temperature started at 17 degrees but didn't increase, showing that the ground had more than enough capacity to cool the water down. The power consumption was relatively stable, however it does reduce slightly towards the end, this is probably due to the water temperature decreasing. However, as the accuracy of the temperature monitoring equipment is 1 degree it is impossible to confirm.

To summarise, for every kW of electricity that the system consumes at 75% load, 4.67kW of Cooling is produced.



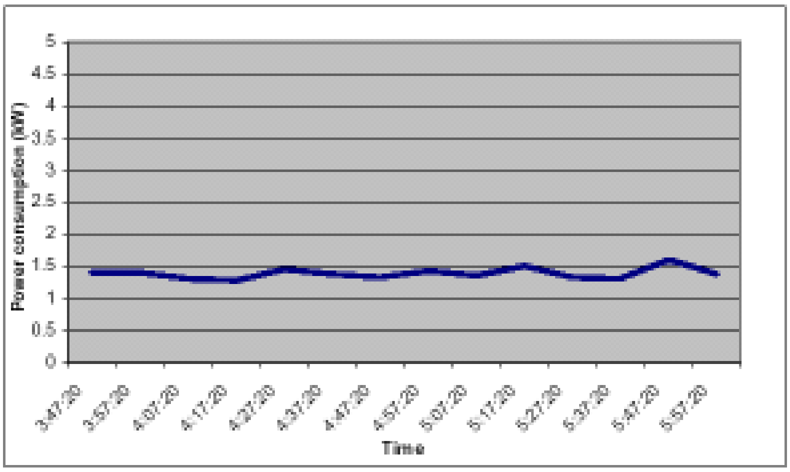


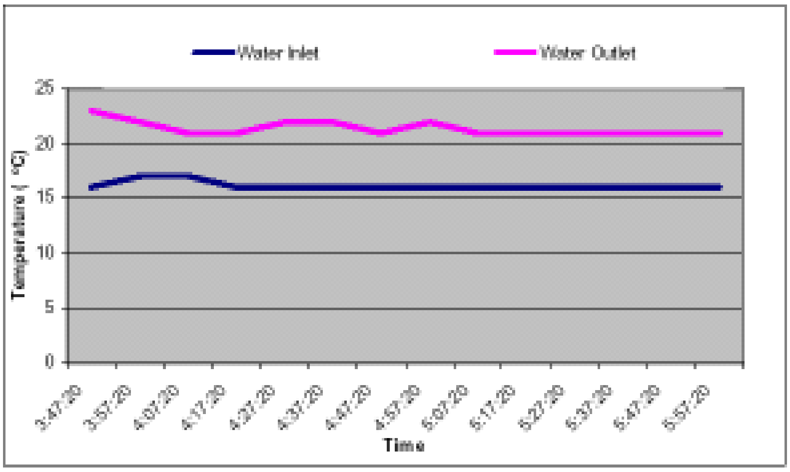
50% Operation.

% Loading	Water Temperature	Cooling Capacity	Average Power Consumption	Average COP
50	16.14	8	1.40	5.73

Again this test followed the 75% test. The power consumption was very stable, due to the constant load on the system. The Water temperature reduces 1 degree during the test. The ground has the ability to dissipate more heat than the water is rejecting to it. The ground temperature and thus the water temperature both reduce as the ground recovers towards its normal 10 degrees.

To summarise, for every kW of electrical power that the system consumed at 50% load, 5.73kW of Cooling was produced.





Heating analysis.

In order to measure the Capacity and Efficiency, the system was run in full heating for 2 weeks before starting the heating analysis, in order to achieve the lowest water temperatures and thus the most stringent conditions possible.

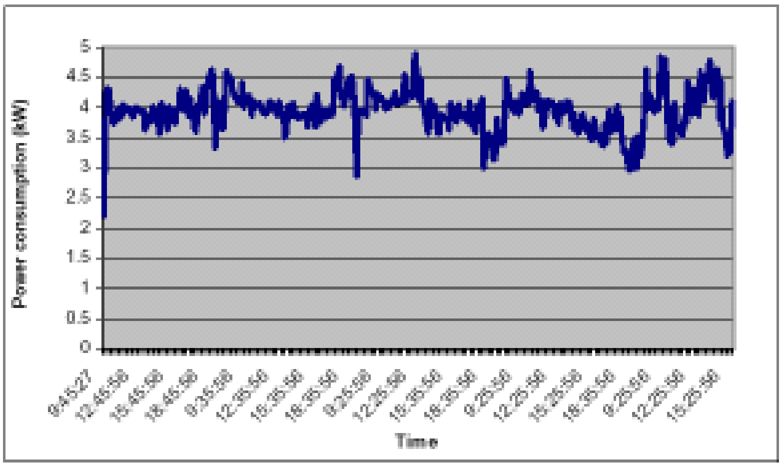
100% Operation.

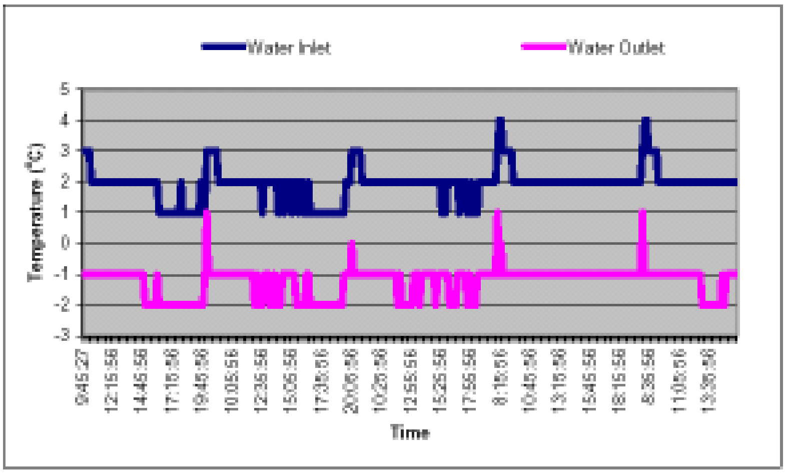
% Loading	Water Temperature	Cooling Capacity	Average Power Consumption	Average COP
100	1.94	18.28	3.94	4.63

The power consumption was very constant at around 3.9kW, proving that the heating load was constant during the test.

The water temperature shows that during the night when the system was not extracting heat from the ground, the ground and thus the water in the loop warmed up, recovering the heat that was lost during the test day. The water temperature raised to between 3 & 4 degrees at the start of the test, reducing quickly to 2 degrees and not going any lower than 1 degree. This proves that the ground had the capacity to heat up the water by the desired 3 degrees required to provide the desired 14kW of heat injection.

To summarise, for every kW of electrical power that the system consumed at 100% load, 4.63kW of Heating was produced.





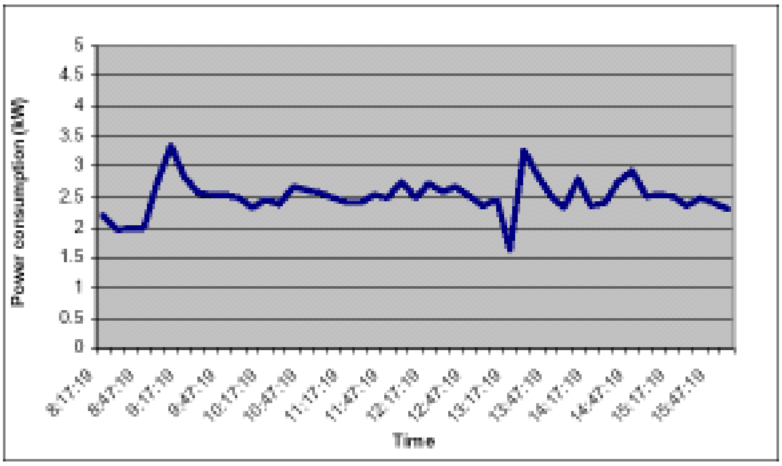
75%Operation.

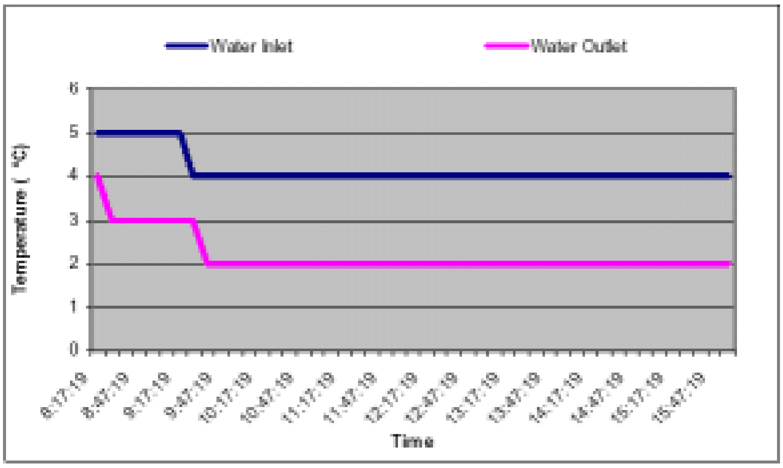
% Loading	Water Temperature	Cooling Capacity	Average Power Consumption	Average COP
75	4.15	13.65	2.51	5.43

This test effectively shows the ability of the ground to recovery the heat energy that the water loop extracts. Just by dropping the heat extraction by 25% allows the ground and thus the water loop to raise its temperature from the 1-2 degrees shown in the 100% operating test up to 4-5 degrees.

The power consumption is again stable showing a constant load on the system.

To summarise, for every kW of electrical power that the system consumed at 75% load, 5.43kW of Heating was produced





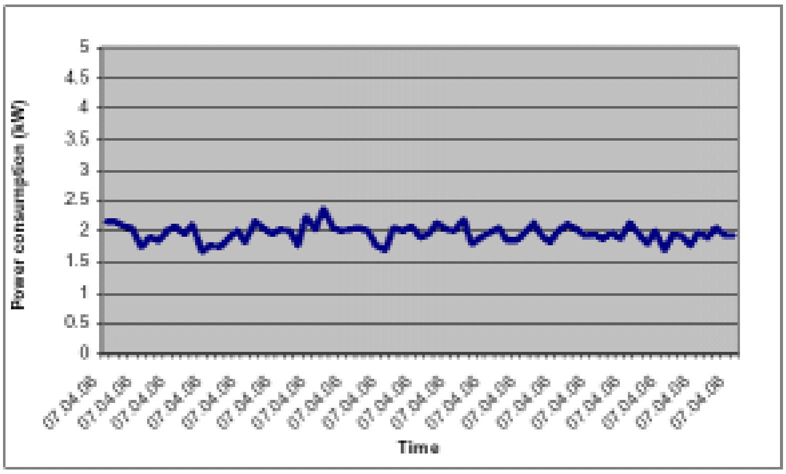
50% Operation.

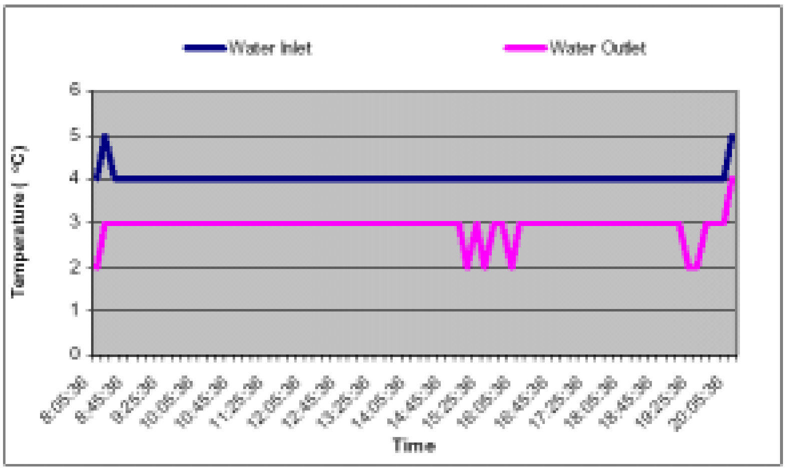
% Loading	Water Temperature	Cooling Capacity	Average Power Consumption	Average COP
50	4.44	9.10	1.97	4.62

The ground at a temperature of about 10 Degrees as a rule of thumb can heat water up to no greater than 5 degrees below the ground temperature i.e. 5 Degrees. This 5 degrees rule is typical of any heat transfer process where the closest the cooled or heated substance can be cooled or heated to is 5 degrees from the heating or cooling source.

So for Closed Loop Ground Source Heat Pump in Heating operation the water temperature will never be greater than 5 degrees

To summarise, for every kW of electrical power that the system consumed at 50% load, 4.62kW of Heating was produced.





Analysis of Annual Running.

Analysis 1. Comparison of Part Load Efficiencies.

Load	PQHY	Chiller
100	5.15	2.5
75	6.08	2.25
50	6.51	2
Average	5.91	2.25

The COP of the Chiller is from the 2006 Energy Technology Listed

262 % More Efficient than the Chiller

Note Average of Early amd Mid Summer Cooling Test COP for PQHY

Heating

18 kW of Heating

Load	PQHY	Boiler
100	4.63	0.95
75	5.43	0.95
50	4.62	0.95
Average	4.89	0.95

515 % More Efficient than the Boiler

Spring & Autumn

Assumed an average of Heating and Cooling

Load	PQHY	Chiller / Boiler
100	4.89	1.725
75	5.755	1.6
50	5.565	1.475
Average	5.40	1.60

338 % More Efficient than the Chiller & Boiler

Analysis 2. WY Yearly Running cost.

Spring / Autumn Power Consumption

Average (kW)	Area (m^2)	Installed Capacity kW	kW / m^2	10 Hour Day cost
2.08	165.00	18.28	0.11	1.16
			Days of Operation	120.00
			Cost	£139.59

Winter Power Consumption

Average (kW)	Area (m^2)	Installed Capacity kW	kW / m^2	10 Hour Day cost
3.95	165.00	18.28	0.11	2.21
			Days of Operation	60.00
			Cost	£132.81

Summer Power Consumption

Average (kW)	Area (m^2)	Installed Capacity kW	kW / m^2	10 Hour Day cost
2.22	165.00	16.00	0.10	1.24
			Days of Operation	60.00
			Cost	£74.58

Total Cost / m^2 year	£ 2.10

Analysis 3. Comparison of Annual Power Consumption.

Boiler	9771.32	kWh	0.19	1856.55	0.0587	573.58

Cooling Season	kW Consumed	Emission Factor		kg CO_2 Emmissions	Emission Factor	kg of Carbon
Ground Source	1065.46	kWh	0.43	458.15	0.117	124.66
Chiller	2791.51	kWh	0.43	1200.35	0.117	326.10

Cooling Season	kW Consumed	Emission Factor		kg CO_2 Emmissions	Emission Factor	kg of Carbon
Ground Source	1994.09	kWh	0.43	857.46	0.117	233.31
Chiller / Boiler	6740.01	kWh	0.31	2089.40	0.088	593.12

Analysis 4. Comparison of Annual CO_2 Emissions and kg of Carbon Produced.

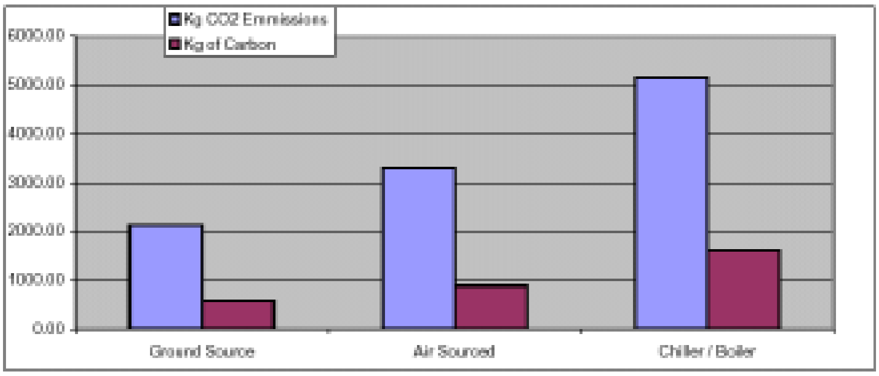
Air Cooled Heat Pump VRF PUHY-P200YGM-A

Assuming a Running cost of £3.25 / m^2 / Year as documented from previous case studies

kWh	kg CO_2 Emmissions	kg of Carbon
7,660.71	3294.107143	896.3035714

Annual Total Emmissions

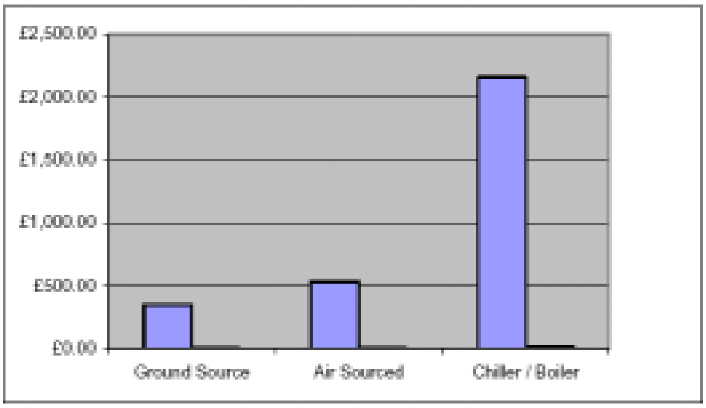
Totals	kg CO_2 Emmissions	kg of Carbon
Ground Source	2131.46	579.96
Air Sourced	3294.11	896.30
Chiller / Boiler	5146.31	1493.30



Analysis 5. Comparison of Annual Running cost.

Annual Running Cost

	Annual Running Cost	Cost / m^2 / year
Ground Source	£346.98	£2.10
Air Sourced	£536.25	£3.25
Chiller / Boiler	£2,160.70	£13.10



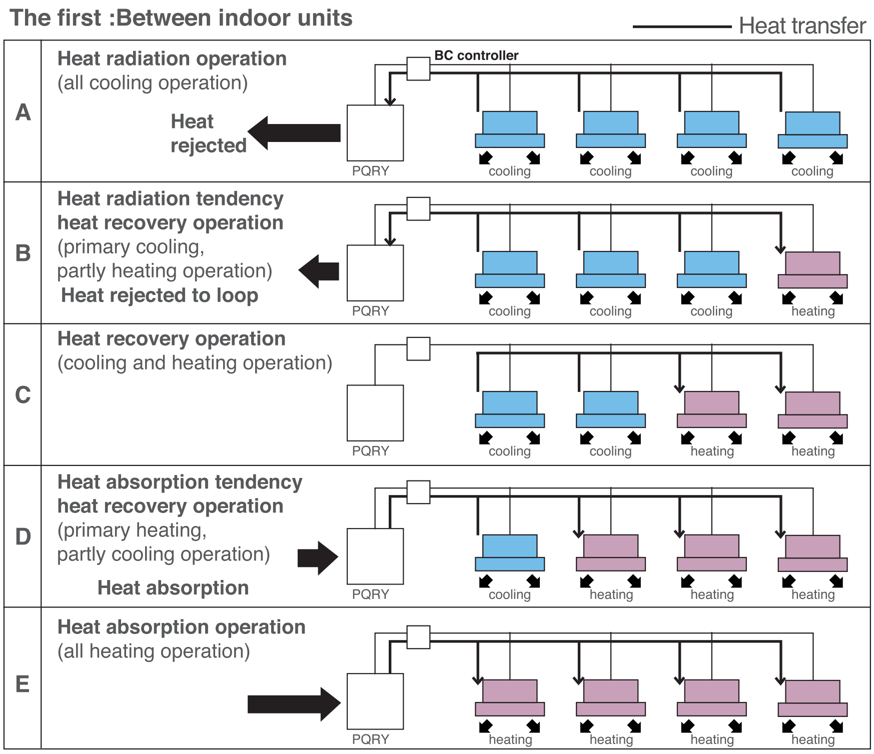
Based on Cost of Electricity £0.07 /kWh
Based on Cost of Gas £0.03 /kWh

Memo

WR2 Heat recovery type

Mitsubishi Electric now offers double heat recovery operation.
The first heat recovery is within the refrigerant system. Simultaneous cooling and heating operation is available, with heat recovery performed between indoor units.
The second heat recovery is within the water loop, where heat recovery is performed among the PQRY units.
This double heat recovery operation substantially improves energy efficiency and makes the system the ideal solution to the requirements of modern office buldings, where cooling is required even in winter, which depends on the amount of sunshine received and the number of people in the room.

1st heat recovery

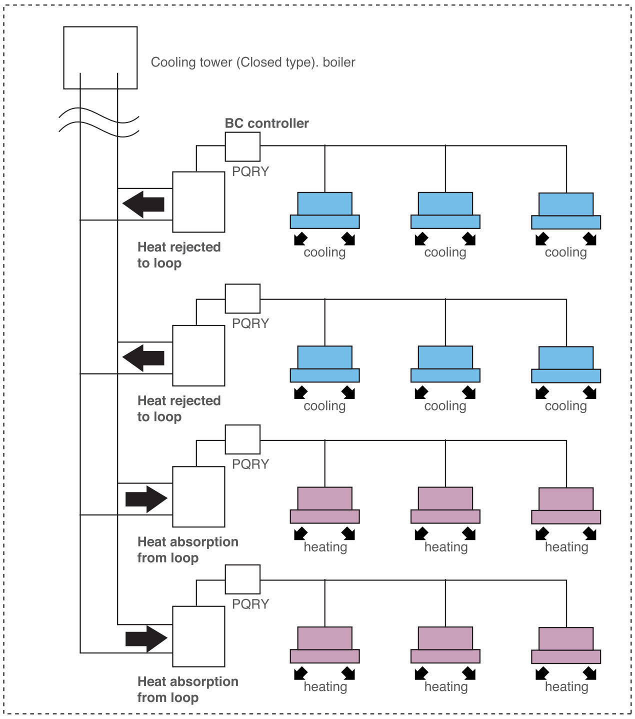


Simultaneous heating and cooling operation within the refrigerant system

In primary cooling, partly heating mode, the system recycles heat exhausted from the cooling operation to use for heating.
In primary heating, partly cooling mode, the system uses cooled post-heating operation refrigerant for cooling. Efficiency can be improved the more simultaneous opreration is performed.

2nd heat recovery

The second : Between PQRY units



Heat recovery operation between the PQRY units

Heat recovery operation is also available between systems connected to the same water loop, with systems exchanging heat via water. This increases energy efficiency.

Installation example

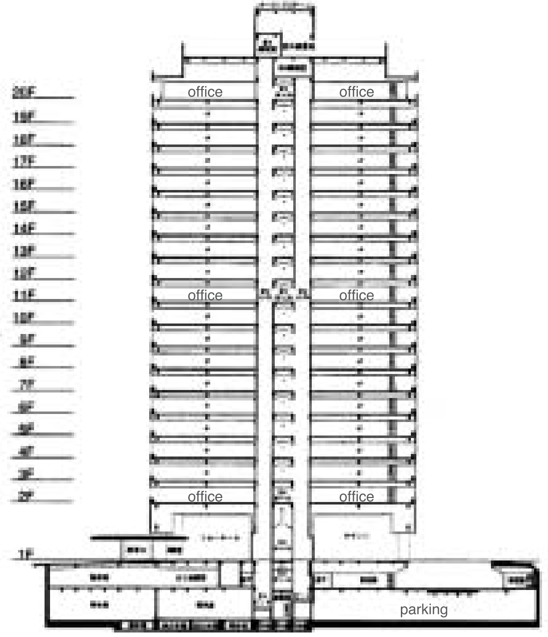
Shin-Fujita Building

Located in Osaka, Japan
> 20 stories
Total floor area
> 47,712m^2
Application
> office use

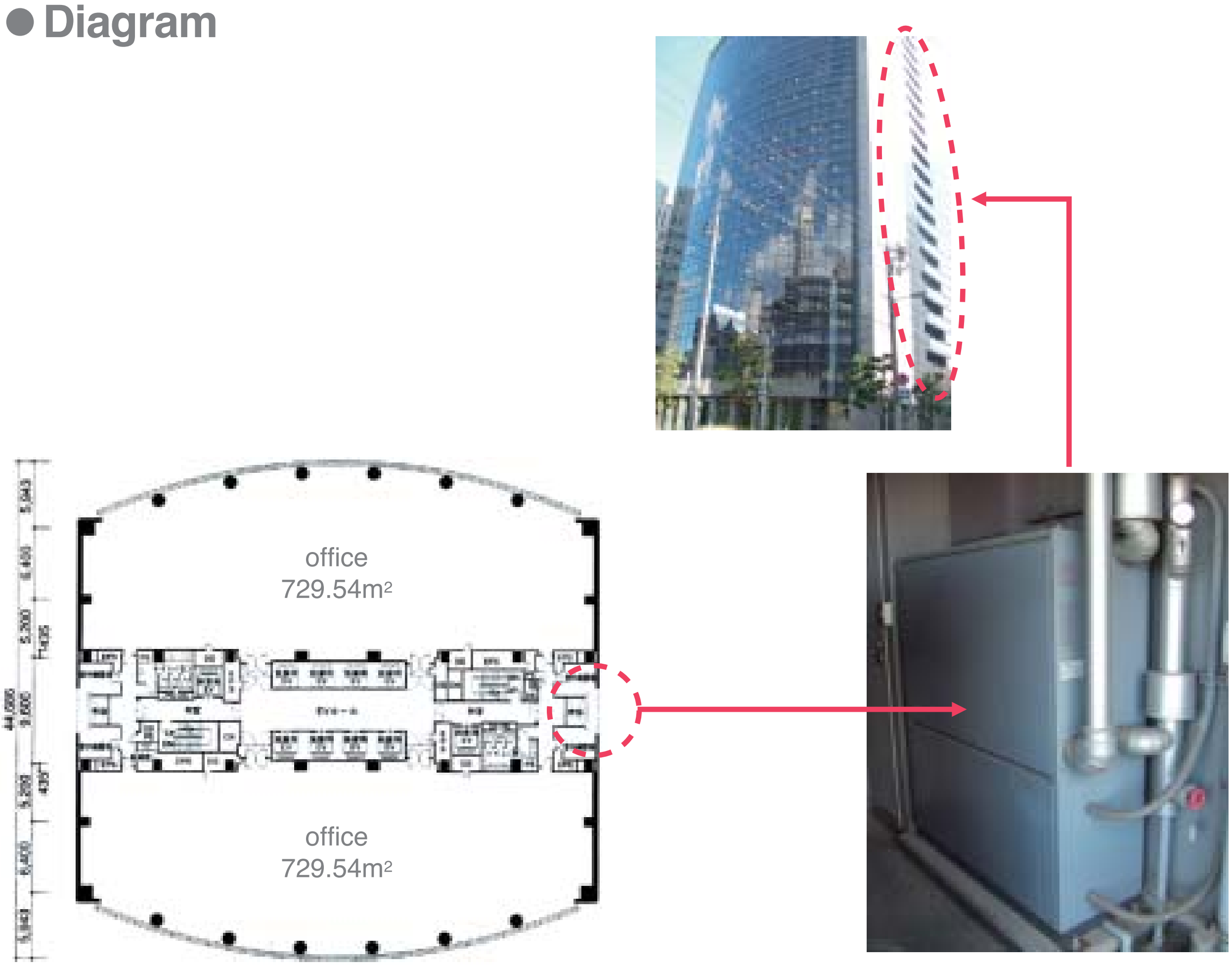
●Total units installed

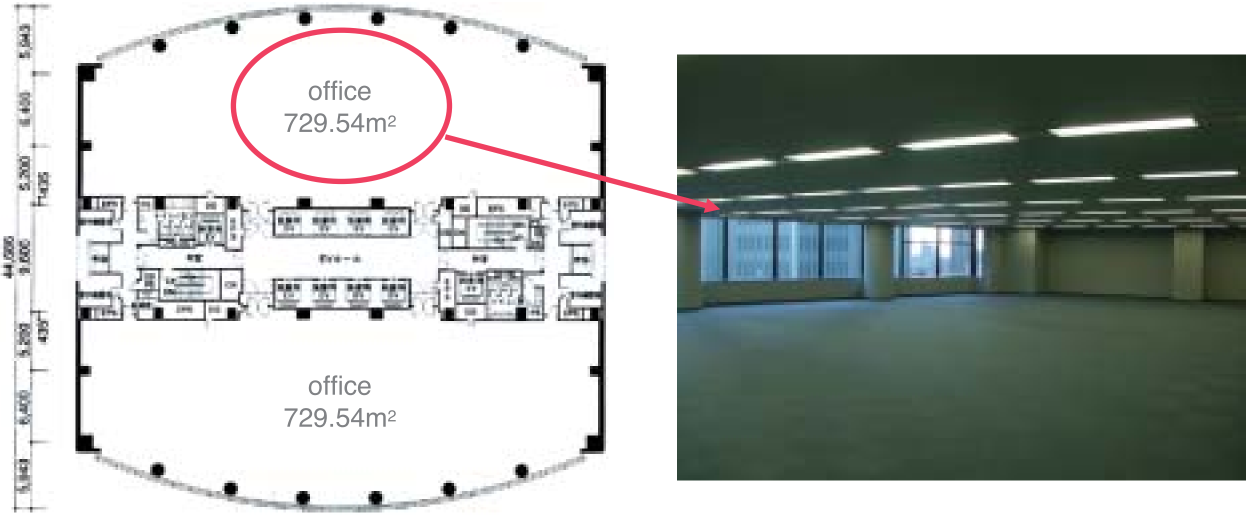
1. PQRY 12pcs / story Indoor 28pcs / story
2. Outdoor : 148 x 8HP + 80 x 10HP = 228 units
3. Indoor : 532units
4. Lossnay 8units (1000m^3/ h) / story (In total 152pcs)
5. Control Building Management System
   MELANS (MJ-102MTR and MB-300 series)
   which commands on / off, operation mode,
   set temperature and monitor
6. Cooling towers and boilers on the roof
   for air conditioning on 1st floor.

Cross-sectional view



● Diagram


office
729.54m2
office
729.54m2


office
729.54m2
office
729.54m2

FM33568 / ISO 9001;2000

The Air Conditioning & Refrigeration Systems Works acquired ISO 9001 certification under Series 9000 of the International Standard Organization (ISO) based on a review of Quality management for the production of refrigeration and air conditioning equipment.

ISO Authorization System
The ISO 9000 series is a plant authorization system relating to quality management as stipulated by the ISO. ISO 9001 certifies quality management based on the "design, development, production, installation and auxiliary services" for products built at an authorized plant.

Certificate Number EC97J1227

The Air Conditioning & Refrigeration Systems Works acquired environmental management system standard ISO 14001 certification.

The ISO 14000 series is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

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