Overseas version simulation software that contributes to the prevention of global warming.

• U.S. Patent No. US 8,396,605 B2

Energy simulation Software

Enepro21 World Edition

Energy Simulation Software of EIE can reduce Carbon Dioxide (CO_2) emission to air by optimizing energy efficiency.

Basic software for building smart energy networks

E.I. Engineering Co., Ltd.

EIE Core business (consulting and software licensing)

Enepro21

EIE provides consulting services and licenses the general purpose simulation software listed below.

Effective system design

Reproduction and analysis of the current operation

Optimal operating support

- Power Generation
- District facilities, Computer centers, Factories
- Proper distribution of Energy
- Effective distribution of unused energy
- Renewable energy, Solar power, Solar heating

Energy Simulation technology

Software for Licensing

Energy Simulation Software Enepro21 WE World Edition

Enepro21 multi

EPS 21 Energy Prediction System

Optimal Operation Guide Enepro21 EXPERT

Supporting information/material
Enepro21 data base
Over 8,000 Equipment performance data Enepro21 How-to video

Accomplishments in Japan since 2005

①EIE is currently licensing Enepro21 to the following customers.

Construction, Utility, Planning, Supplier and Universities are benefiting from result of Enepro21's analysis and obtained significant savings.

• Nihon Sekkei.INC. * •NIKKEN SEKKEI LTD• Kanden Energy Solution Co., Inc.
•International Petroleum Development Co., Ltd. *• Tokyo Gas Co., Ltd. • Tokyo Gas Engineering Solutions Co., Ltd.,
•Kyudenko * • Toho Gas Co., Ltd. * • OSAKA GAS CO.,Ltd. • Daigas energy • Tokyo Heat Supply
• Mitsubishi Electric CO.,Ltd. (Advanced Technology R&D Center) • Takenaka Co., Ltd.
•Shinjuku Minami Energy Service (JR Tokai) • Shibaura Institute of Technology * • Yokohama National University *
• Kogakuin University * Use multiple

②Consulting experience

Power generation equipment

①CCPP: 1,705,000kW
②Gas turbine cogeneration: 441,400kW
③ Gas engine cogeneration: 591,400kW

Energy saving and cost saving for district heating and cooling, individual buildings, hospitals, hotels, factories, industrial parks, etc.
Consulting experience Refrigerated ton base: 681,200RT

Features of Enepro21 World Edition

Enepro21

- Enepro21 is a general-purpose simulation software for heat source facility and can be usable all over the world.
  - ・The language of the software is written in English.
  - ・The unit consists of SI units, which are international units common throughout the world.
  - ・Solar power generation and solar heat simulations can be used in any country by setting the time difference from Universal Time (UTC).

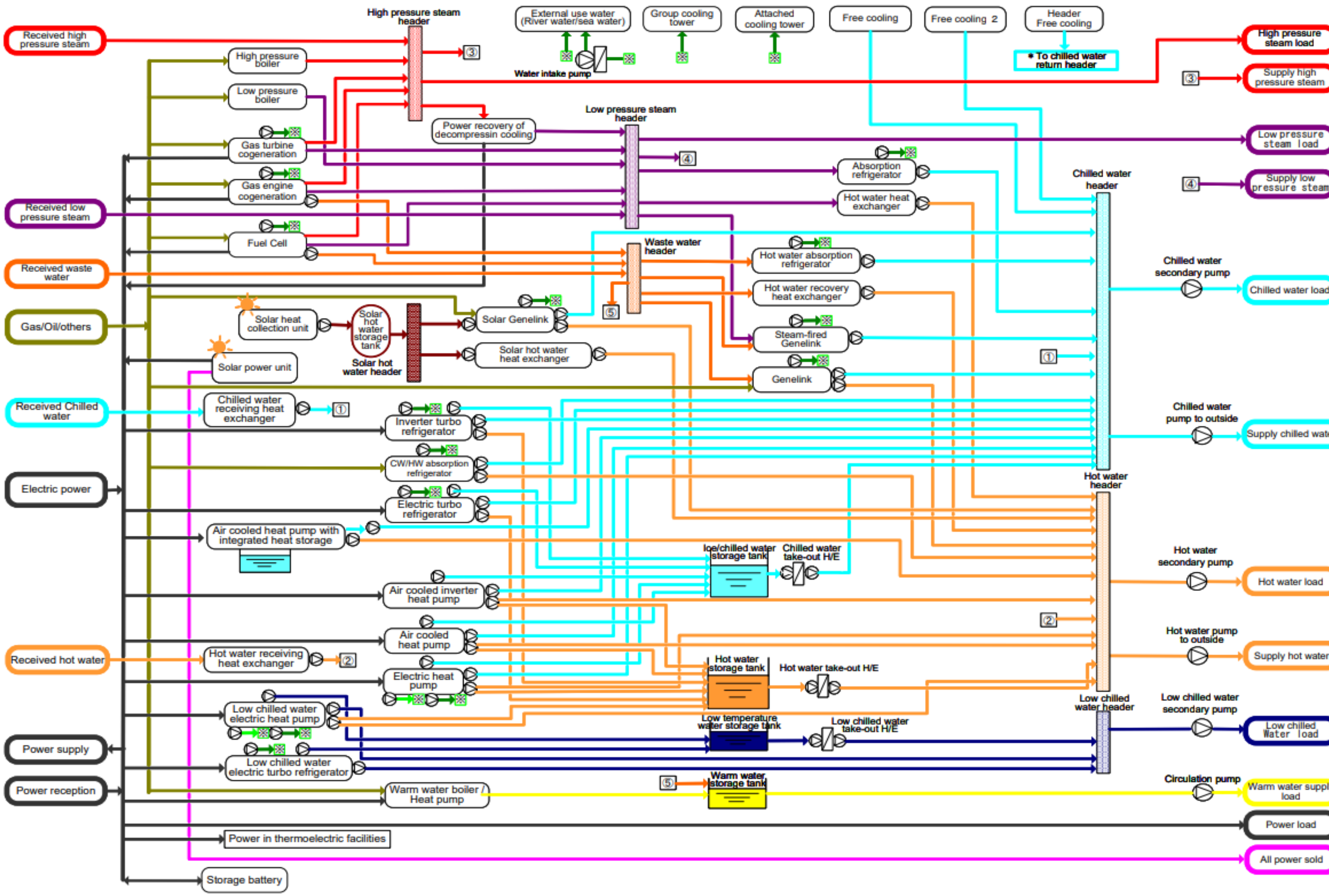
- To meet the complex utility costs around the world, the "Detailed Utility Consumption List" output outputs 365 days of hourly utility consumption in Excel format.
  You can freely calculate the cost and environmental load.

- Enepro21 can be used to design and analyze various centralized energy facilities such as power generation facilities (CCPP, GT, GE, fuel cells, storage batteries), renewable energy (solar energy, solar heat utilization).

- Enepro21 can reproduce the actual operation results of the existing facility within error rang of 1to 2 % per year.

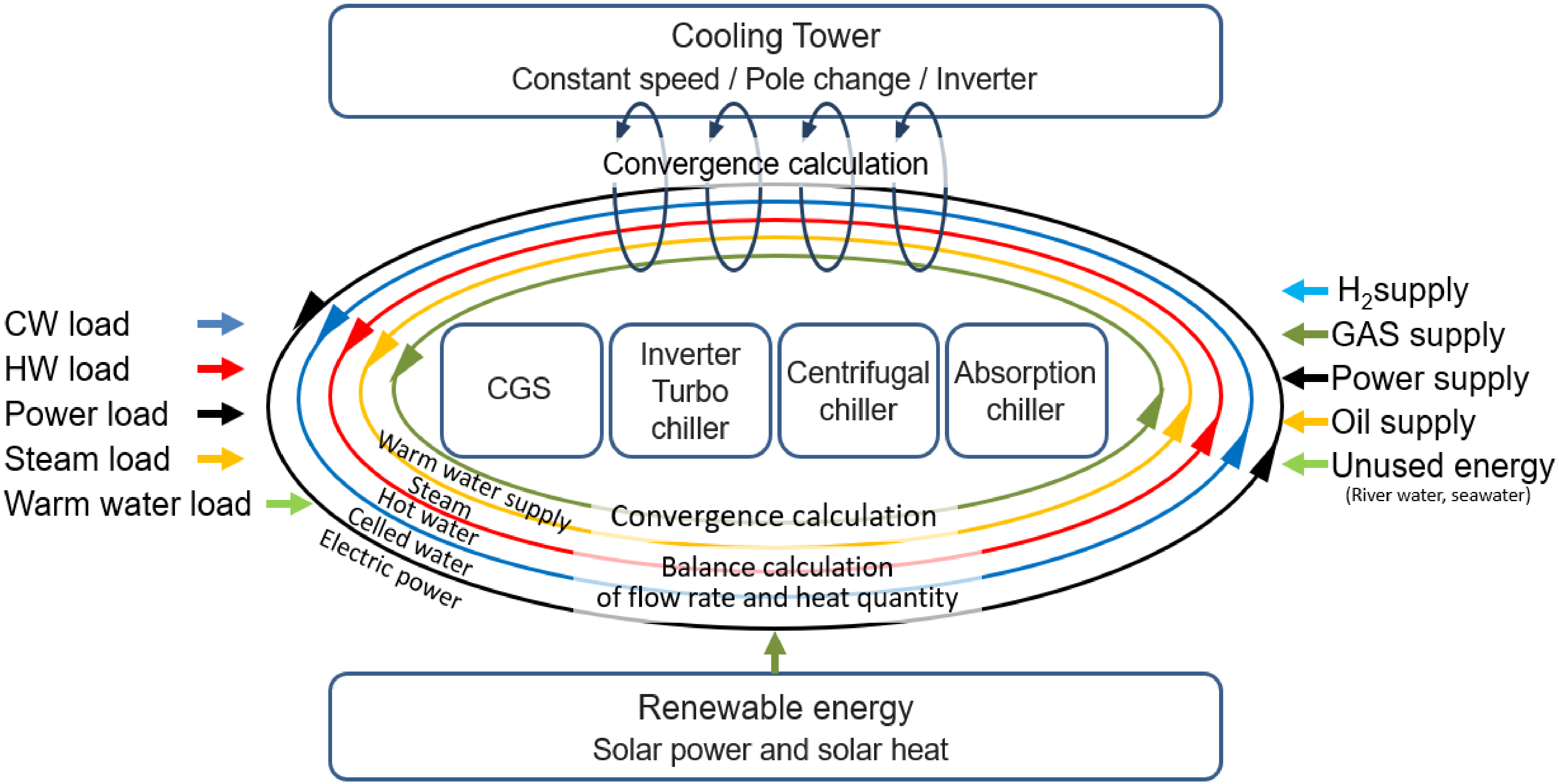
  (Accurately reproduce the operating state by making full use of convergence calculation to balance the power, heat and flow rate)

Standard model flow of Enepro21 World Edition



Structure of Enepro21World Edition

A surplus solar power from the nearby generator can be collected and utilized.



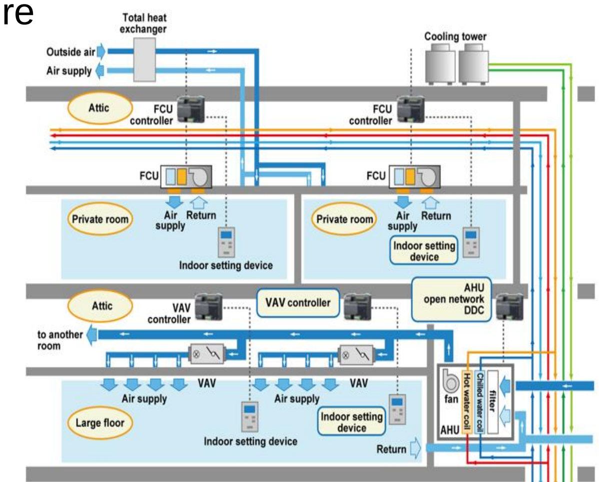
Relationship between building air-conditioning system and heat source system (HVAC)

● The control results of temperature, humidity and outside air ventilation by the air conditioning system in the building side are summarized in the required energy amount on the building side and the temperature difference of the heat medium.

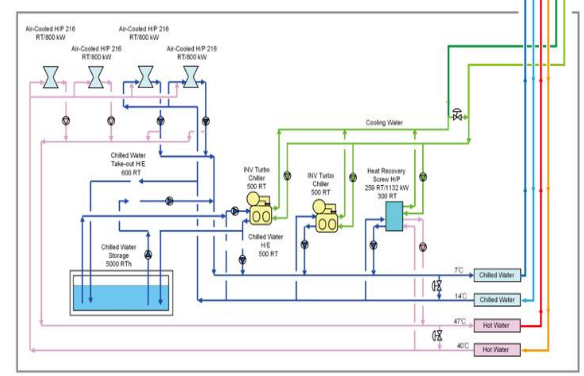
● After all, under the condition of the linked temperature difference between inlet and outlet of the heat medium, the requirement of energy for the building must be sent by the heat medium to the building side from the heat source as to be less cost and CO_2 minimum.

● Thus, "building side air conditioning system" and "heat source system" can be designed and analyzed separately under the conditions of the heat medium.

Building air conditioning system



● 「EnergyPlus」 software which is used worldwide is recommended for the calculation of the building side for heat load calculation. On the other hand, the energy consumption and carbon dioxide (CO_2) production of the heat source system are greatly affected by many factors such as the temperature of the cooling water in the cooling tower, the control method of the pump, the supply temperature of the heat medium and the temperature difference of the heat medium. Enepro21 World Edition, a general-purpose simulation software, has been successfully used in Japan and is the best simulation software for designing and analyzing heat source facility.



Heat source system

Consulting procedure by Enepro21 World Edition

Enepro21

●Accurately reproduce the annual operation status of existing facility (error range of 1to2%)

●Enepro21 World Edition allows you to accurately calculate and compare operating costs and carbon dioxide (CO_2) emissions when considering how to operate an existing facility or renew an existing facility.

Step-1

Suggestion of the operation improvement plan by changing the operation conditions. (due to changes in operational parameters)

- Calculate the effect of energy saving and cost reduction by changing the various operation parameters, the priority order of operation of equipment and operation time period of cogeneration unit
- Calculate the cost saving and CO_2 reduction by changing the operation load and parameter of equipment

Analysis of equipment performance

Select the optimum case from the comparison table

Step-2

Study of the countermeasures for energy/cost saving and Carbon Dioxide (CO_2) reduction by the small investment.

- Introduce the inverter pump, free cooling and pump with excess flow rate etc.

Step-3

Propose the energy/cost saving and Carbon Dioxide (CO_2) reduction by adding the equipment and/or optimizing the facility

- Employ the new equipment such as cogeneration + Genelink, heat accumulation equipment and reusable energy
- Propose the optimized renewal plan by considering the future load forecast and energy cost.

Enepro21 World Edition : License Overview

Enepro21 World Edition License Overview

Provision of the reliable information and the consulting service

Reliable / Provision of information

Web Enepro21 Utilization data

Equipment performance data

Vast data of over 8,000 units are collected from various users

Accurate and fast calculation
Easy to use

Enepro21

License

Customer

Accumulation of data and know-how

Accurately reproduce the annual operation status of the existing facility

Case files

Prompt and reliable consulting

Enepro21 World Edition : Easy to use for engineers (1)

- If you need to consider a newly proposed facility, load the case file for the previously considered facility. By substituting the information and load of the proposed facility and new equipment, you can easily and quickly consider the newly proposed facility.
- Several engineers, proposing their ideas, can construct a system of the new proposed facility together based on the common case file.
- Until the adopted equipment data is obtained, the simulation study can be done in advance by downloading the similar equipment performance data from Enepeo21 data base.
- The hourly calculation is done instantly, and the annual calculation result can be quickly calculated, so you can make various studies under different conditions.
- Creating Reports, graphs, and forms is simple and easy by exporting the data to Excel.
- There is a help function for each open screen, and the calculation formula is also described, so you can easily understand the contents.

Enepro21 Word Edition: Easy to use for Engineers (2)

- Warnings to prevent erroneous calculations:
  - Outlet temperature of the equipment
  - Duplicated equipment
  - The variance of the temperature of the equipment

- Useful functions
  - Enthalpy input (pressure input MPaG)
  - Calculation of pump capacity and pump efficiency

- The equipment data can be shared among the users.

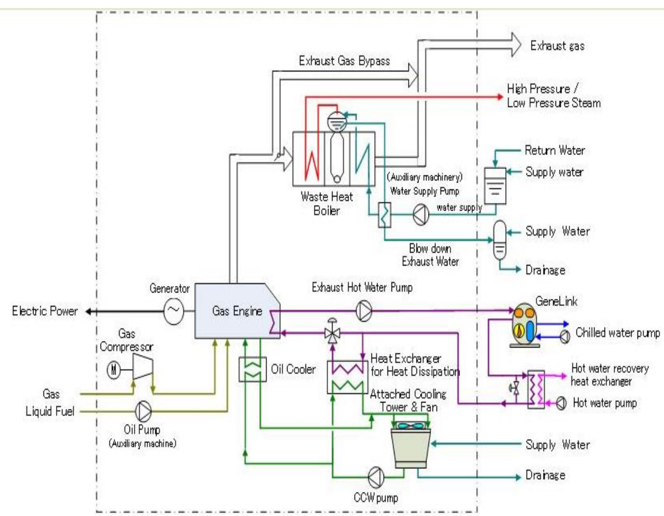
- For setting priority equipment:
  the balance calculation is performed with consideration of the flow rate and the amount of heat to start only the number of equipment required.

- Enepro21 automatically calculates the number of equipment to drive.
  And you can make accurate corrections from the saved records.

Content

4.3 Gas Engine cogenerator

4.3.1 Model System diagram



4.3.6 Calculation expression

1) Fuel consumption

From Expression 4. 3. 2

$$\text{Fuel consumption [Nm3/h]} = \frac{\text{kW [kW]} \times 3.6\ \text{[MJ/kWh]}}{\text{Lower fuel heating value [MJ/Nm3]} \times \text{kW [\%]}} \times 100$$

Expression 4. 3. 9

2) Actual vaporization amount of waste heat boiler

Combining Expression 4.3.2, Expression 4.3.3, and Expression 4.3.6, the rated actual vaporization amount of the waste heat boiler can be obtained as follows:

$$\text{Actual vaporization amount [kg/h]} = \frac{\text{kW [kW]} \times 3600\ \text{[kJ/kWh]}}{\Delta H_S\ \text{[kJ/kg]} + \Delta H_B\ \text{[kJ/kg]} \times \text{Blow rate [\%]}/100} \times \frac{\text{Steam heat recovery rate [\%]}}{\text{kW [\%]}}$$

Expression 4. 3. 10

where

ΔH_S [kJ/kg] = Steam enthalpy [kJ/kg] − water supply enthalpy [kJ/kg]

ΔH_B [kJ/kg] = Blowdown water enthalpy [kJ/kg] − water supply enthalpy [kJ/kg]

At a certain electricity generation output (kW), the power generation efficiency and the waste hot water heat recovery ratio can be determined from the load factor and the performance data.

3) First, the fuel consumption (Nm3/h) is determined by Expression 4.3.9, and the amount of heat recovery from waste hot water is calculated by the following expression.

Amount of heat recovery from waste hot water First, the fuel consumption (Nm3/h) is determined by Expression 4.3.9, and the amount of heat recovery from waste hot water is calculated by the following expression.

First, the fuel consumption (Nm3

/h) is determined by Expression 4.3.9, and the amount of heat recovery from waste hot water is calculated by the following expression. [MJ/h]

$$= \text{Lower fuel heating value [MJ/Nm3]} \times \text{Fuel consumption [Nm3/h]} \times \frac{\text{Waste HW heat recovery ratio [\%]}}{100}$$

Expression 4. 3. 11

4) Waste heat

The waste heat has to be calculated to determine the flow rate of the cooling water pump and the power consumption of the cooling tower fan.

Gas engine waste heat can be calculated by Expression 4.3.11 as follows:

Enepro21World Edition: Video learning function

- Enhancement of learning function by using the operation video with sample case of Enepro21
  The operation videos as listed below have been prepared for the users to use the simulation function of Enepro21 effectively.
  The users can learn by the videos over and over again at any time. time.

- From startup / load creation to calculation execution for those who use Enepro21 for the first time

- Basics:16 thematic training videos

①Program Configuration and Project File
②Example of Creating Thermoelectric Loads Based on the Heat Load Basic Unit
③Example of Creating Thermoelectric Loads Based on the Measured Data（Excel）
④Importing / Modifying / Enabling Thermoelectric Load Data
⑤ Basic Condition Setting
⑥Creating System Configuration and Use of Equipment Performance Data Collection
⑦Pump Power Calculation and Control Method Setting
⑧Equipment Model Setting for a System with CGS
⑨Equipment Model Setting for a System with Heat Storage
⑩Operation Plan Setting and Convenient Functions
⑪Calculation Execution and Output of the System with CGS
⑫Calculation Execution and Output of the system with Heat Storage
⑬Example of Comparative Study of Operating Methods of the Systems with CGS
⑭Secondary Pump System Setting
⑮Summary of Convenient Functions
⑯Basic Concept of Chilled Water Balance

- Advanced version：Video of simulation example incorporating Know-How of EIE

①Settings of Solar Power Generation System
②Settings of Solar Heat Utilization System
③Settings of Tamdem Type Turbo Chiller
④Settings of Free Cooling System
⑤Trial Calculation of the Primary Energy Conversion Coefficient for Cold and Hot
⑥Trial calculation of the Primary Energy Conversion Coefficient for Cold and Hot for the System Using CGS Exhaust Heat

Automatic connection of device data related to the main equipment

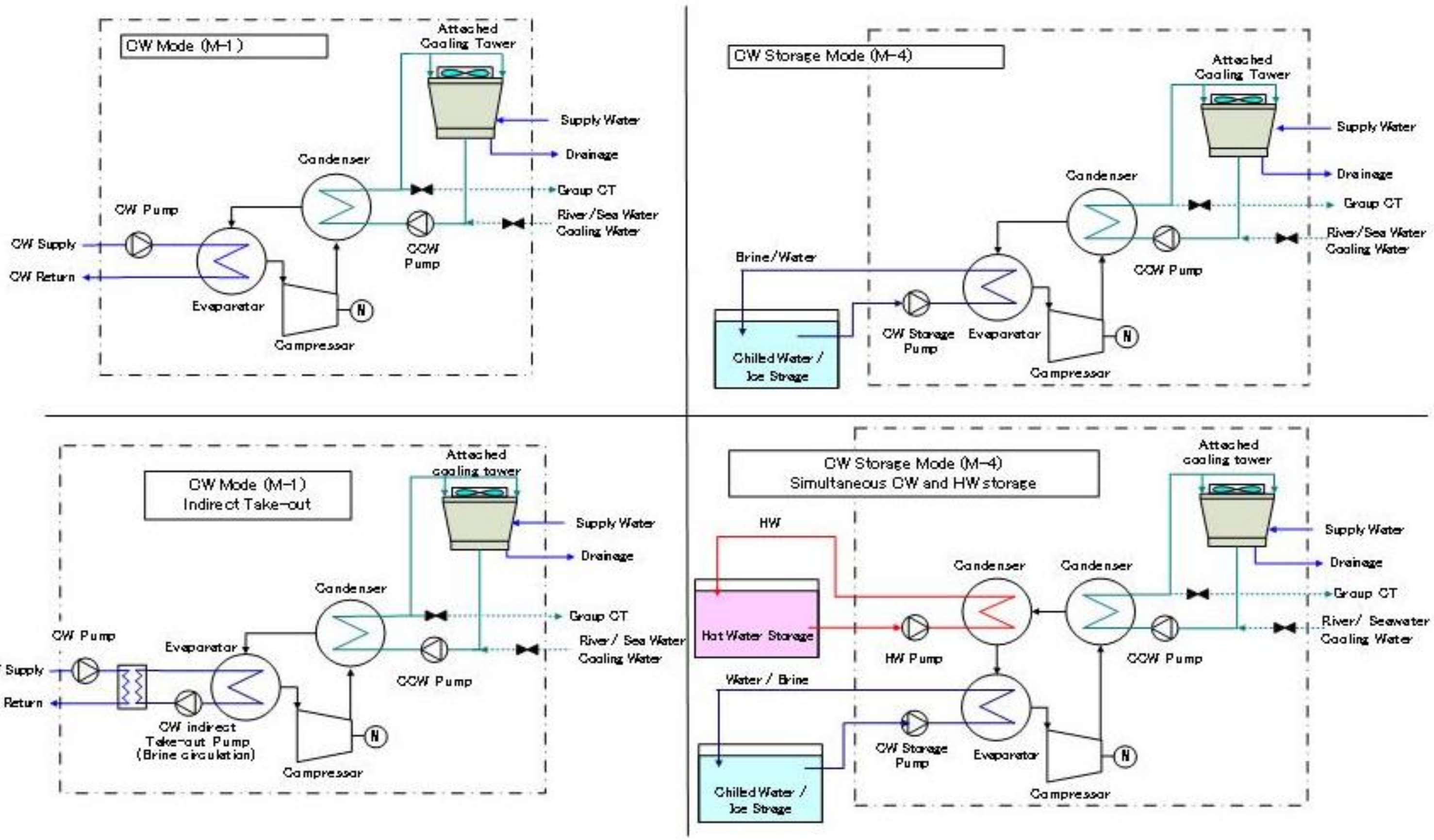
Enepro21

- Equipment data

The related equipment within the dotted line are automatically connected.

･Related pumps (Chilled water pump, cooling water pump, heat storage pump, hot water pump, etc.)

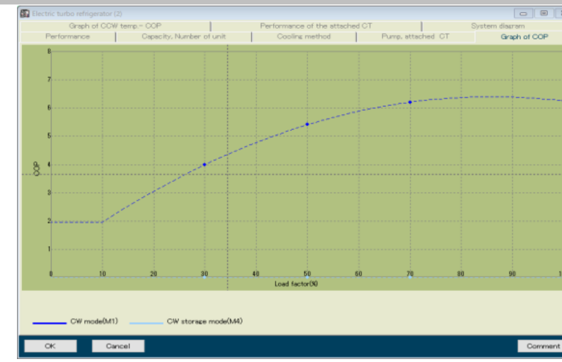
･Attached cooling tower ･Heat storage tank ･Heat exchanger



Equipment performance data
(Data is automatically entered by downloading from the equipment database)

Equipment performance data

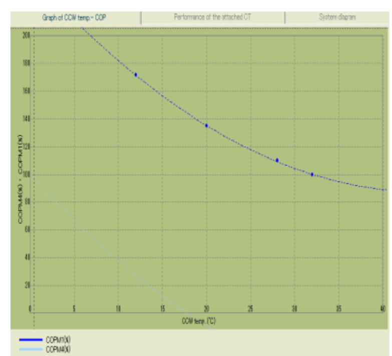
①The equipment characteristics (COP) are created by a regression equation by inputting the numerical values of four load factors at the reference cooling water temperature and the reference chilled water outlet temperature.



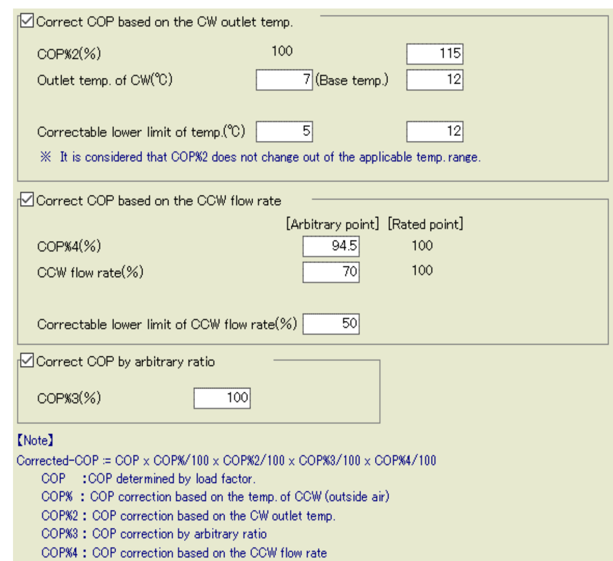
②Equipment characteristics are automatically corrected by cooling water temperature correction, chilled water outlet temperature correction, cooling water flow rate correction, and aging correction.
(To accurately reproduce the actual operation)

$$COP^{(E)} = COP \times \frac{COP\%}{100} \times \frac{COP\%2}{100} \times \frac{COP\%3}{100} \times \frac{COP\%4}{100}$$

COP (E) Corrected COP used for energy calculation
COP COP determined by load factor(cooling water reference temperature)
COP% [%] COP correction by cooling water temperature
COP% 2 [%] COP correction by chilled water outlet temperature
COP% 3 [%] COP correction due to aging
COP% 4 [%] COP correction by cooling water flow rate



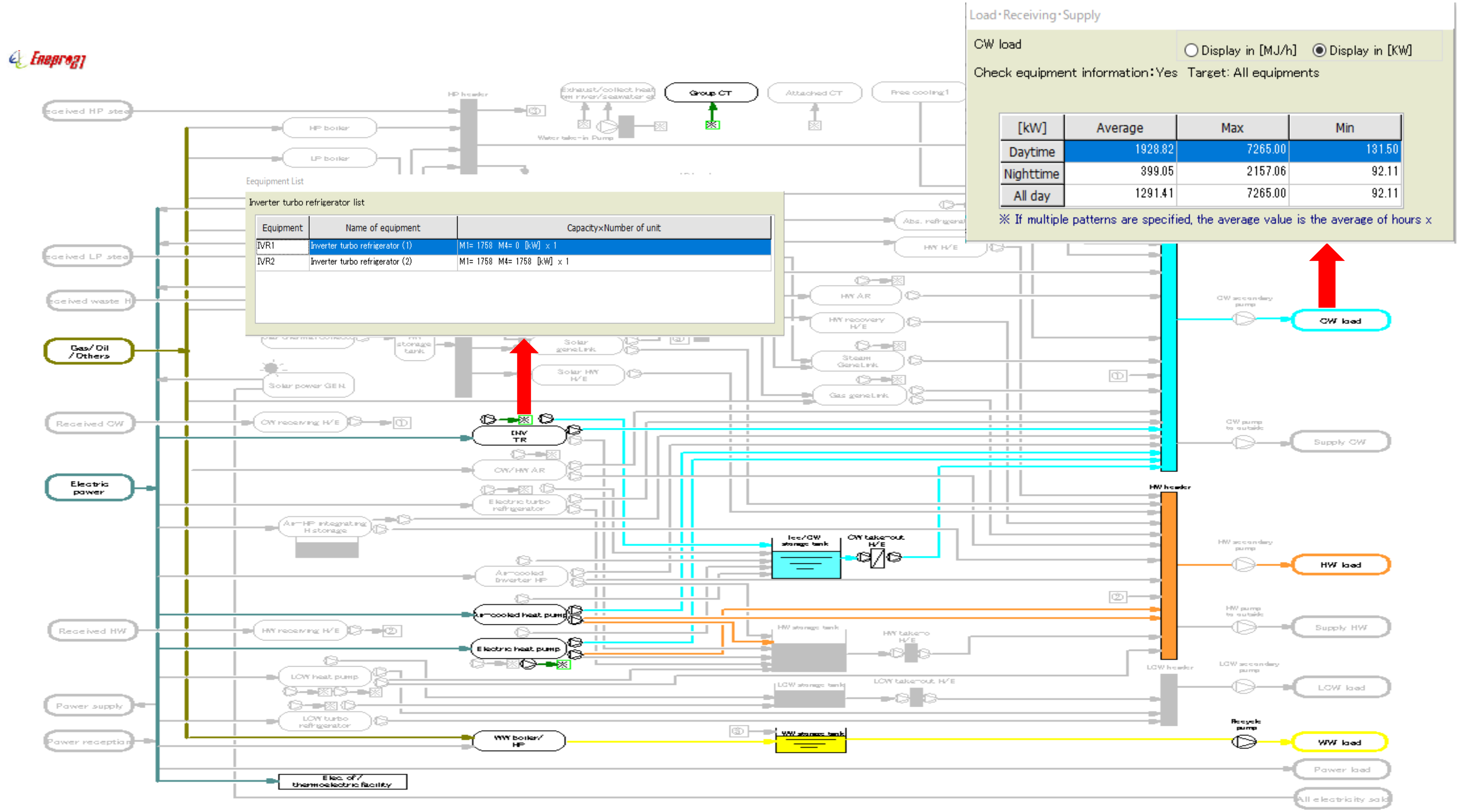
Cooling water temperature correction curve



System construction procedure (with heat load connected)

- The data of the download device can be read into the system flow, and multiple system that matches the load can be built.

The optimum solution can be easily obtained by comparing the systems.



Equipment List

Inverter turbo refrigerator list

Equipment	Name of equipment	Capacity×Number of unit
IVR1	Inverter turbo refrigerator (1)	M1= 1758 M4= 0 [kW] x 1
IVR2	Inverter turbo refrigerator (2)	M1= 1758 M4= 1758 [kW] x 1

Load･Receiving･Supply

CW load ○Display in [MJ/h] ◉Display in [KW]

Check equipment information:Yes Target: All equipments

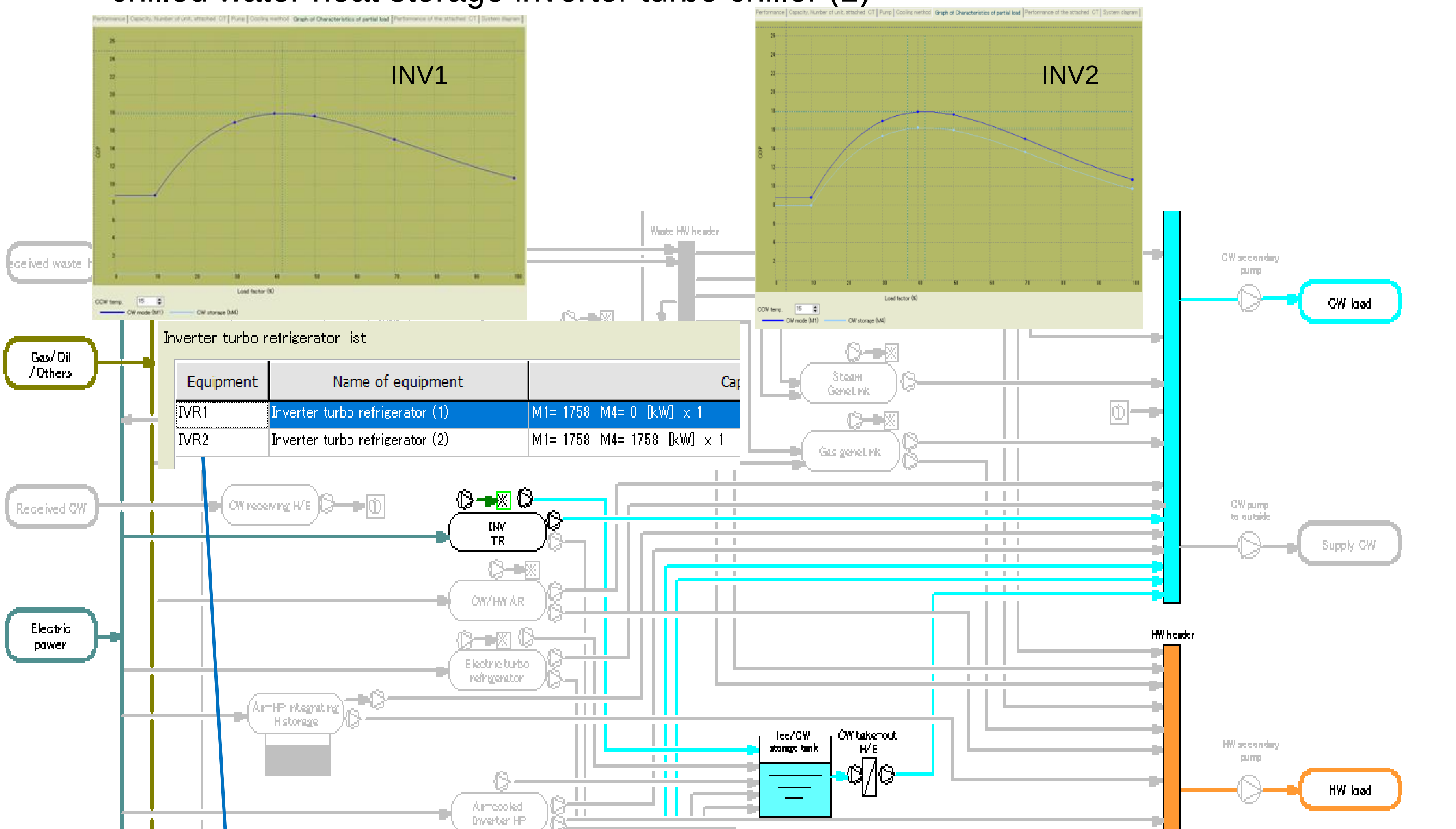
[kW]	Average	Max	Min
Daytime	1928.82	7265.00	131.50
Nighttime	399.05	2157.06	92.11
All day	1291.41	7265.00	92.11

※ If multiple patterns are specified, the average value is the average of hours x

Example of reading the INV turbo chiller from the database into the system

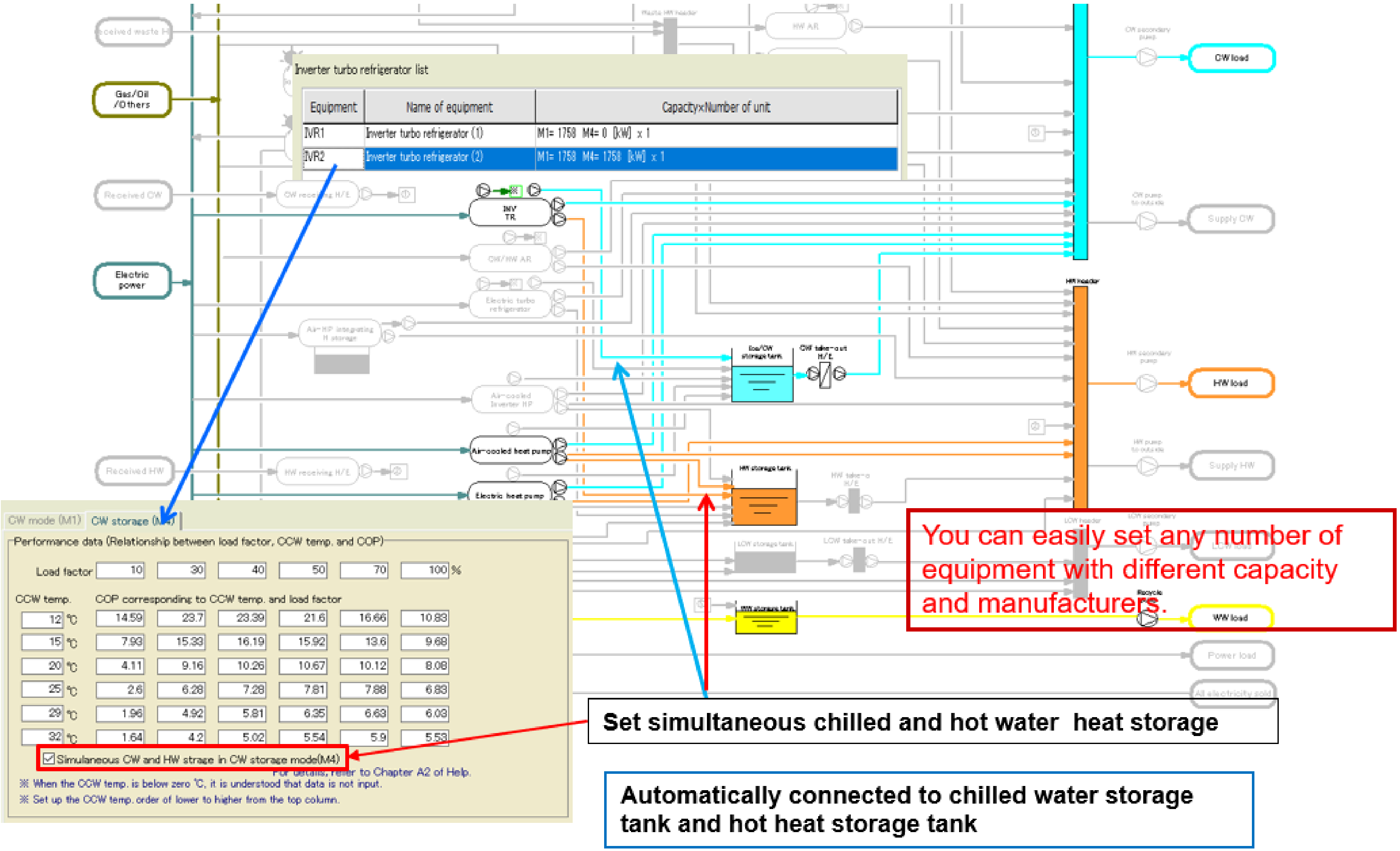
Enepro21

- Reading the chilled water dedicated inverter turbo chiller (1) and chilled water heat storage inverter turbo chiller (2)



INV1 is automatically connected to the power and chilled water header.
Similarly, INV2 is connected to electricity, a chilled water header, and a chilled water storage tank.

Setting of simultaneous chilled and hot heat storage of inverter turbo chiller



Inverter turbo refrigerator list

Equipment	Name of equipment	Capacity×Number of unit
IVR1	Inverter turbo refrigerator (1)	M1= 1758 M4= 0 [kW] x 1
IVR2	Inverter turbo refrigerator (2)	M1= 1758 M4= 1758 [kW] x 1

CW mode (M1) | CW storage (M4)

Performance data (Relationship between load factor, CCW temp. and COP)

CCW temp. \ Load factor (%)	10	30	40	50	70	100
12 ℃	14.59	23.7	23.39	21.6	16.66	10.83
15 ℃	7.93	15.33	16.19	15.92	13.6	9.68
20 ℃	4.11	9.16	10.26	10.67	10.12	8.08
25 ℃	2.6	6.28	7.28	7.81	7.88	6.83
29 ℃	1.96	4.92	5.81	6.35	6.63	6.03
32 ℃	1.64	4.2	5.02	5.54	5.9	5.53

COP corresponding to CCW temp. and load factor

☑ Simultaneous CW and HW strage in CW storage mode(M4)

For details, refer to Chapter A2 of Help.

※ When the CCW temp. is below zero ℃, it is understood that data is not input.

※ Set up the CCW temp. order of lower to higher from the top column.

Engineering for Tomorrow

with Enepro21World Edition

E.I. Engineering Co., Ltd.