Layout Mode Edition

Field Logic, Inc.

Version 1.0

Contents

1. Introduction

About This Document (Tutorial)

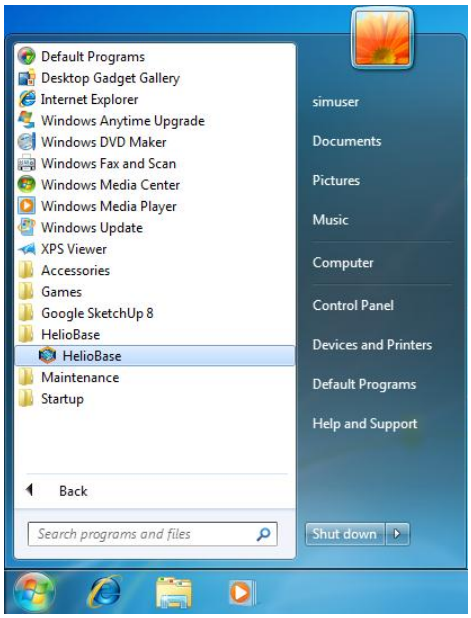
HelioBase® is an application that predicts the generated output of a photovoltaic system (PV). This document describes how to calculate the predicted generated output where the designer of the photovoltaic system configures the PV arrays. This tutorial describes the basic operations: the program starts where the designer defines the location of the system and sets the conditions of the meteorological data, defines the layout of the PV arrays, configures the building layout, and then calculates and verifies the results.

You will learn the basic operations of *HelioBase*® through these operations.

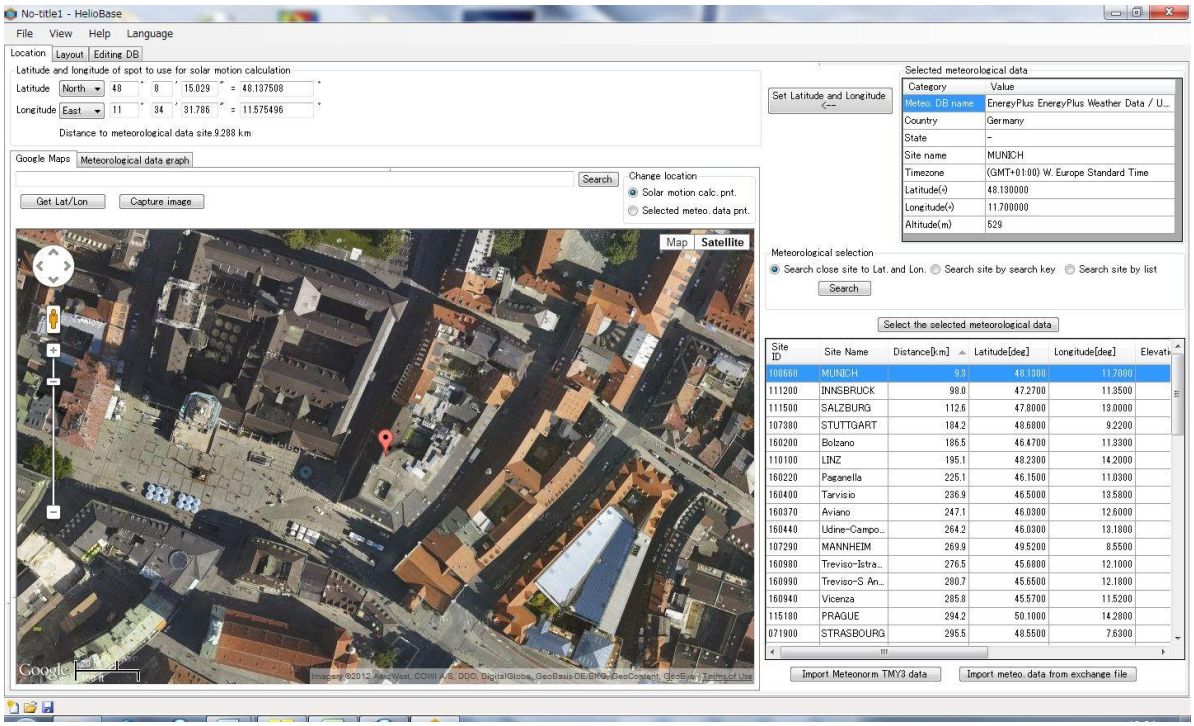
2. Starting *HelioBase®*

Operation: Start *HelioBase®.*

① Click the Windows [Start] button, click [All Programs], then click [HelioBase®]-[HelioBase®].



② *HelioBase®* starts.



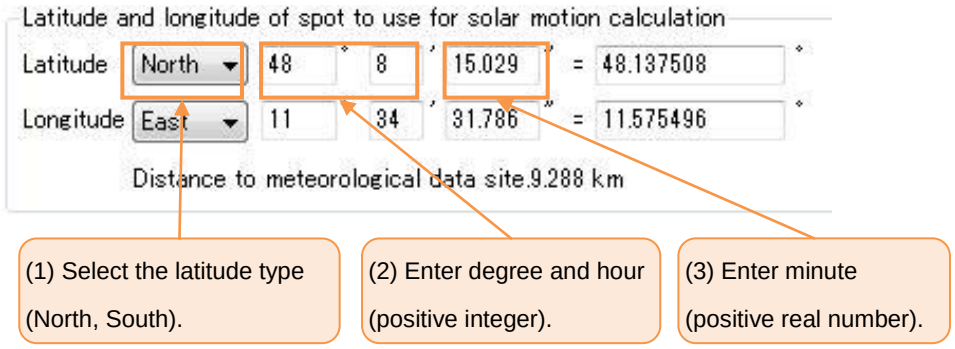
3. Set the Location

Define the location (latitude, longitude) and the meteorological data to simulate the power generation.

Set the latitude and longitude

Operation: Set the latitude and longitude of the location to simulate

① Enter the latitude (degree, arc-minute, arc-second) to simulate in the [latitude and longitude of the spot to use for solar motion calculation] box.

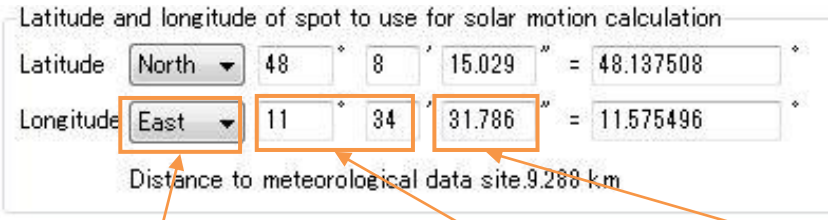


(1) Select the latitude type (North, South).

(2) Enter degree and hour (positive integer).

(3) Enter minute (positive real number).

② Similarly, enter the longitude (degree, arc-minute, arc-second).



(4) Select the longitude type (East, West).

(5) Enter degree and hour (positive integer).

(6) Enter minute (positive real number).

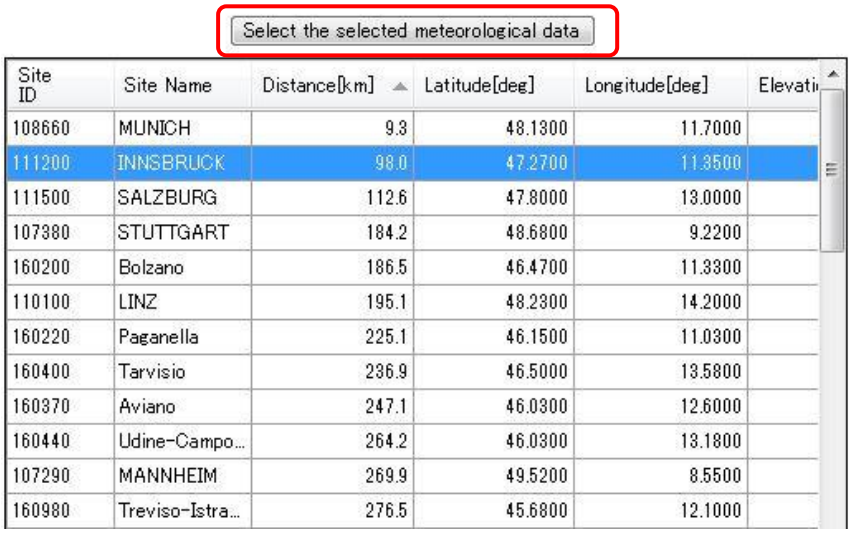
Select the meteorological data

Operation: Select the meteorological data for simulation.

① Click the [Search close site to Lat. and Lon.] radio button.

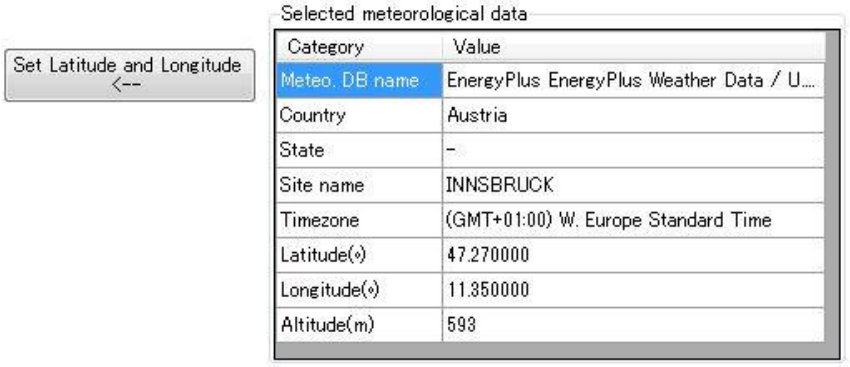
② The following [Meteorological selection] box is shown. Click the [Search] button.

③ The [Meteorological data site list] is updated. Click the line of the site near the location. Click the [Select the selected meteorological data] button.



Site ID	Site Name	Distance[km]	Latitude[deg]	Longitude[deg]	Elevati
108660	MUNICH	9.3	48.1300	11.7000	
111200	INNSBRUCK	98.0	47.2700	11.3500	
111500	SALZBURG	112.6	47.8000	13.0000	
107380	STUTTGART	184.2	48.6800	9.2200	
160200	Bolzano	186.5	46.4700	11.3300	
110100	LINZ	195.1	48.2300	14.2000	
160220	Paganella	225.1	46.1500	11.0300	
160400	Tarvisio	236.9	46.5000	13.5800	
160370	Aviano	247.1	46.0300	12.6000	
160440	Udine-Campo...	264.2	46.0300	13.1800	
107290	MANNHEIM	269.9	49.5200	8.5500	
160980	Treviso-Istra...	276.5	45.6800	12.1000	

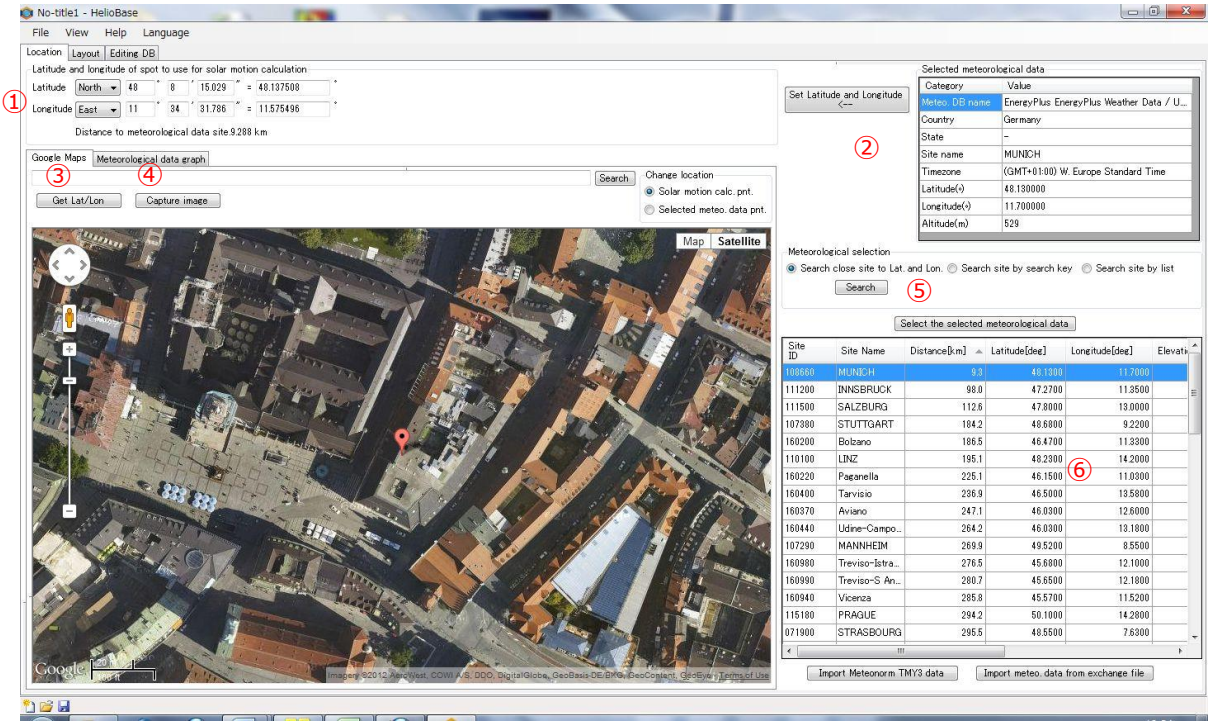
④ The [Selected meteorological data] box is updated to the data of the selected site.



◇NOTE◇

[Location] – Screen configuration

The following shows the screen configuration of the [Location] tab.



① [Latitude and longitude of spot to use for solar motion calculation]... Sets the latitude and longitude of the location for the actual simulation.

② [Selected meteorological data] ... Shows the meteorological data used for simulation.

③ In this tab, you can search location and get latitude and longitude, and check the selected meteorological data point.

④ Shows the graph of the irradiance and temperature data of the selected meteorological point.

⑤ [Meteorological selection]... Selects the method to select the meteorological data.

⑥ Displays the list of the meteorological points searched in ③.

4. Place the PV Array

Select the PV module to use

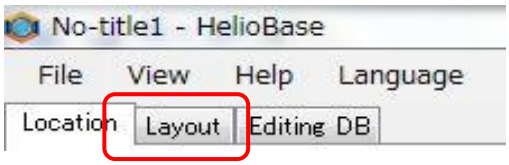
Operation: Select the PV module to use in the simulation.

This tutorial uses the following PV module:

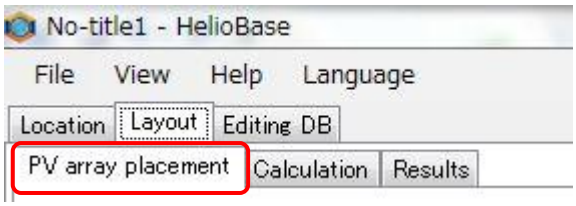
Manufacturer: FieldLogic

Model: SP-90

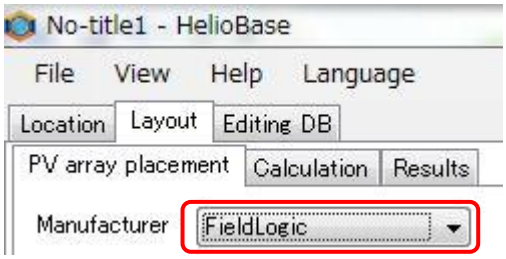
① Click the [Layout] tab. The [Layout] tab opens.



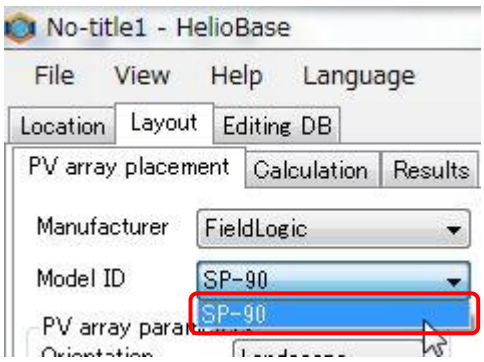
② Click the [PV array placement] tab (upper left corner of the [Layout] screen). [PV array placement] opens.



③ Select [FieldLogic] in the [Manufacturer] list box.



④ Select [SP-90] in the [Module ID] list box.



⑤ The PV module is selected.

Specifying the PV array parameters

Operation: Set the parameters (PV array configuration, installation method, etc.) for the simulation.

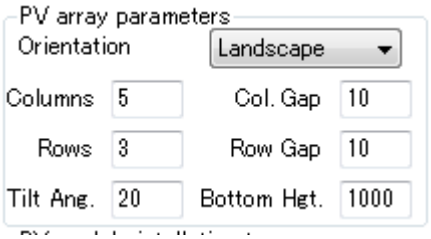
This tutorial defines the following parameters:

Module Direction: Landscape

horizontal direction：4 columns,　vertical direction：3 rows

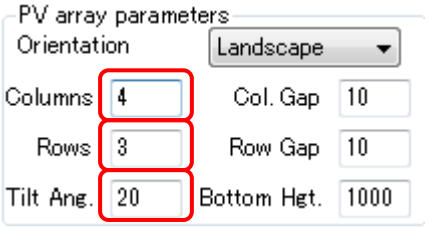
Tilt Angle: 20° frame installation

① Change the values in the [PV array parameters] box.



② Select [Landscape] in the [Orientation] list box.

③ Enter "4" in [Columns]. Enter "3" in [Rows]. Enter "20" in [Tilt Angle].



◇NOTE◇

Parameters in details

[Orientation]…Installation direction of the PV module to configure the PV array.

[Columns]… No. of PV modules placed horizontally that configure the PV array.

[Rows]… No. of PV modules placed vertically that configure the PV array.

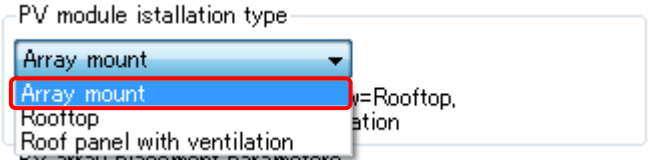
[Tilt Angle]… Inclination angle of the PV array against the horizontal plane

[Col. Gap]… Distance between the PV modules (in the PV array) in the horizontal direction (Unit: mm)

[Row Gap] Distance between the PV modules (in the PV array) in the vertical direction (Unit: mm)

[Bottom Hgt.] Distance from the horizontal plane to the bottom of the PV array (Unit: mm)

④ In the [PV module installation type] list box, select [Array mount].



◇NOTE◇

[PV module installation type] - Details

One of the following three methods can be selected:

[Array mount]

[Rooftop]

[Roof panel with ventilation]

Changing the [PV module installation type] changes the parameters to calculate the PV module temperature.

⑤ The PV array parameters are set.

Placing the PV array in a location in the 2D drawing

Operation: This application has two methods to place the PV array: [Placing in an arbitrary position] and [Automatic placing so that the PV array can be placed within the specified area]. Here, place the PV array in an arbitrary position according to the following conditions:

PV array orientation: Directly south

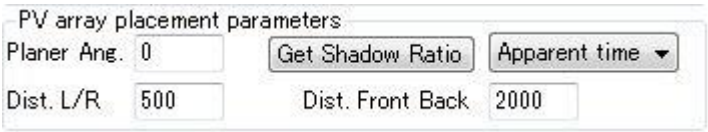
Distance between PV arrays (left/right): 500mm

Distance between PV arrays (front/back): 1000mm

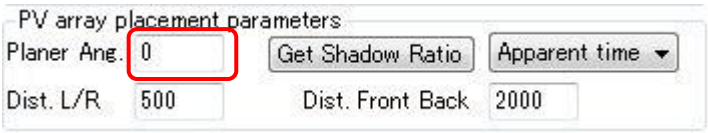
No. of PV arrays (left/right): 5

No. of PV arrays (front/back): 3

① Set the parameters in the [PV array placement parameters] box, and specify the PV array orientation and the distance between the PV arrays.

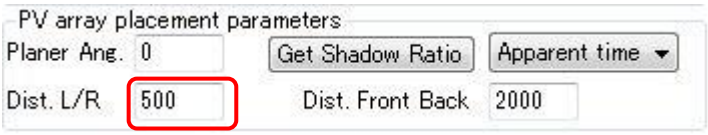


② Enter "0" in [Planer Ang. for South].



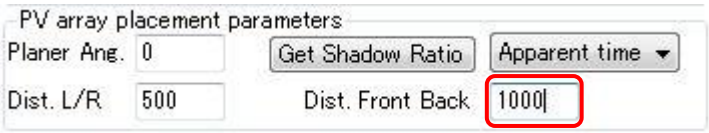
This parameter specifies the PV array orientation in degrees (-180°～+180° counterclockwise) where direct south is 0°.

③ Enter "500" in [Dist. Left Right].



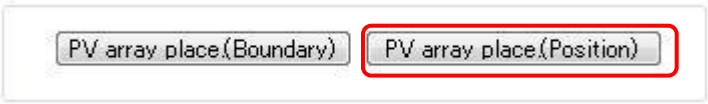
This parameter specifies the distance between placed PV arrays (left/right). (Unit: mm)

④ Enter "1000" in [Dist. Front Back].

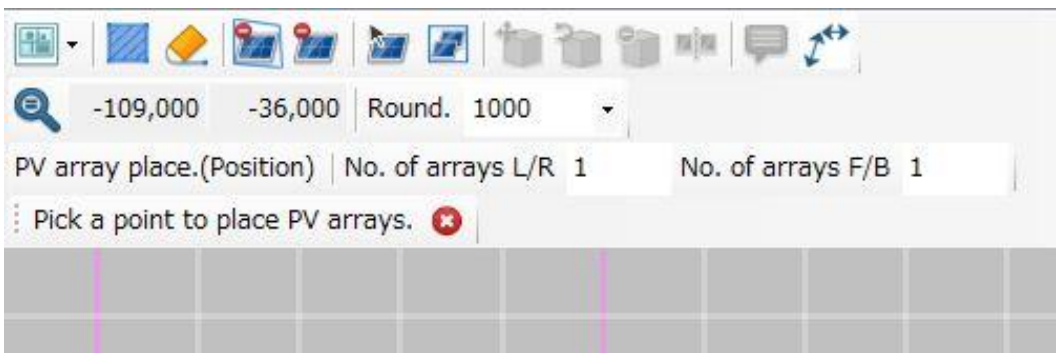


This parameter specifies the distance between placed PV arrays (front/back). (Unit: mm)

⑤ Click the [PV array place.(Position)] button.



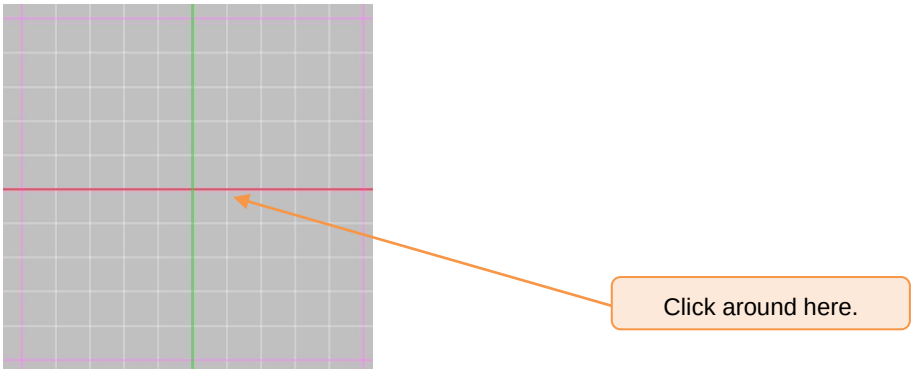
⑥ The [PV array place.(Position)] mode is enabled. The tool bar of upper part of 2D drawing area changes, as shown in the following figure.



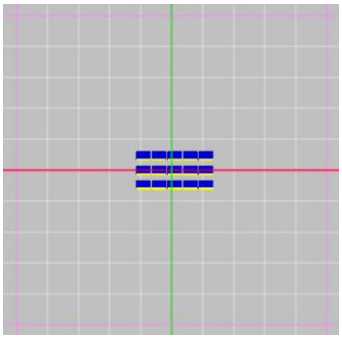
⑦ Enter "5" in [No. of arrays L/R dir.].

⑧ Enter "3" in [No. of arrays F/B dir.].

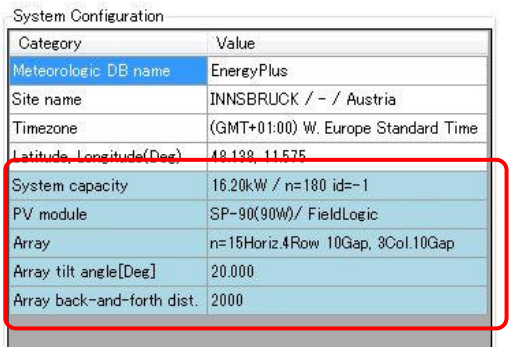
⑨Click the arbitrary point. (In this document, click around the center of the 2D view.)



⑩The PV arrays (No. of PV arrays specified) are placed in the clicked location.



The data for the placed PV array is also added in the [System Configuration] box (lower left of the screen).



◇NOTE◇

2D drawing – Menu bars: Operation

The following describes the menus (red boxes):

① Toolbar	Icons for operation modes
② [Initialize Zoom] button	Initializes the display position and display magnification to display all PV arrays placed in the 2D drawing.
③ Cursor coordinates	Shows the coordinates of the mouse cursor in the 2D drawing.
④ Rounding setting	Specifies the rounding unit of the coordinates when the mouse cursor specifies the coordinates in the 2D drawing. (Unit: mm)

2D drawing – Mesh (line)

Pink	Auxiliary line drawn every 50m.
White	Auxiliary line drawn every 10m.
Yellow	Auxiliary line drawn every 1m.
Green	Auxiliary line drawn in the "south/north" direction through the origin in the 2D drawing.
Red	Auxiliary line drawn in the "east/west" direction through the origin in the 2D drawing.

Changing the display position

Dragging the mouse in the 2D drawing, the display area moves to the direction of the drag.

Enlarge/shrink

While the mouse cursor is in the 2D drawing, rotating the mouse wheel in the front/back direction enlarges/shrinks the image from the center (mouse cursor).

◇NOTE◇

It is possible to move, copy, rotate and delete the PV array.

Select one of toolbar icons.

Each icon means as follows.

①	Move, Copy	Move or copy PV arrays.
②	Rotate	Rotate PV arrays.
③	Delete	Delete PV arrays.

The mode is changed to corresponding one. Enter the distance or degrees. Then click [OK] .

Click [cancel] to finish the mode.

※Be care full to use rotate function. Initial PV array orientation is used for simulation even if you change it after placed on the modeling space.

Splitting up the PV array

Select the PV array by using [Selected Object/PV array split] button .

[PV array split] mode is enabled. Click the [Apply] icon .

The selected PV array is split up. And the [Selected Object/PV array split] mode is canceled.

※This function cannot be used if the Column number of [PV array parameters] is not even.

Set the PV array placement area in the 2D drawing and place the PV array

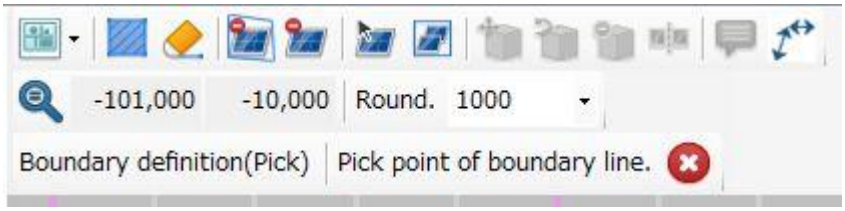
Operation: Set the PV array placement area in the 2D drawing and automatically place the PV array completely within the area.

Here, set a rectangle PV array placement area and place 10 PV arrays.

① Set the PV array placement area in the 2D drawing.

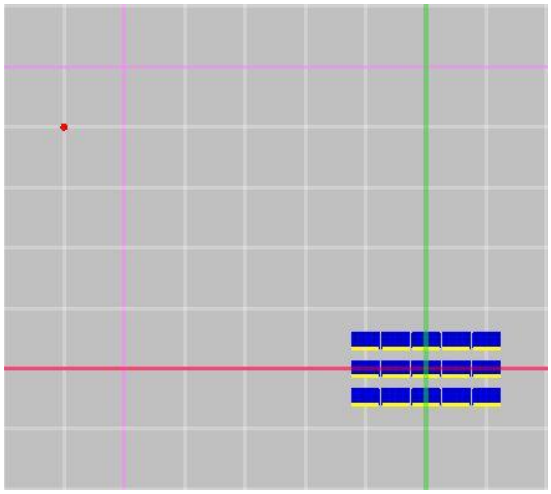
② Click [Boundary definition (Pick)]  in the toolbar in the 2D drawing.

③ The mode is changed to the [Boundary definition] mode, and the following toolbar (icons) are shown.

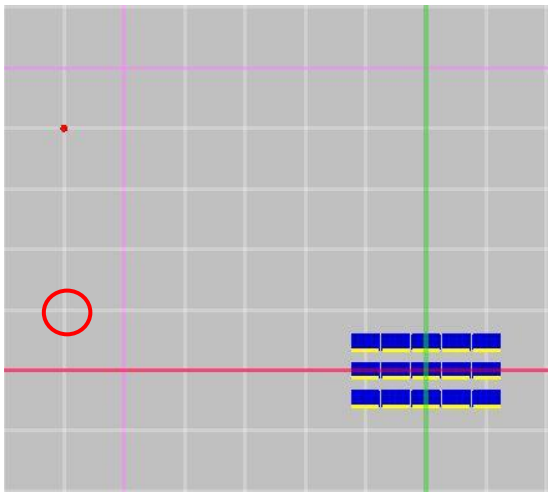


④ In this state, click a location (upper left from the center of the 2D drawing) as shown below (the circled area).

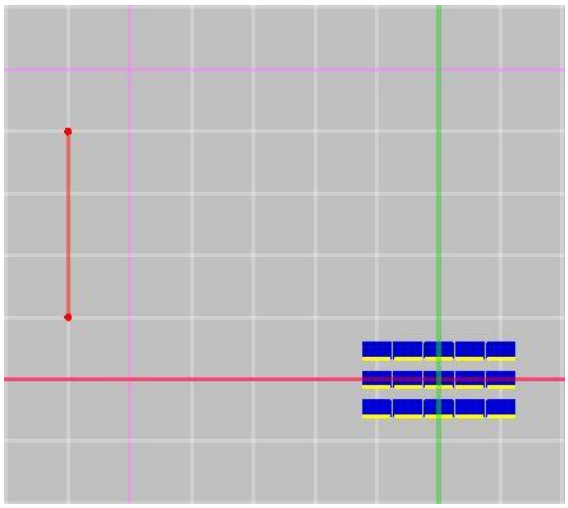
⑤ A red dot is drawn in the clicked position.



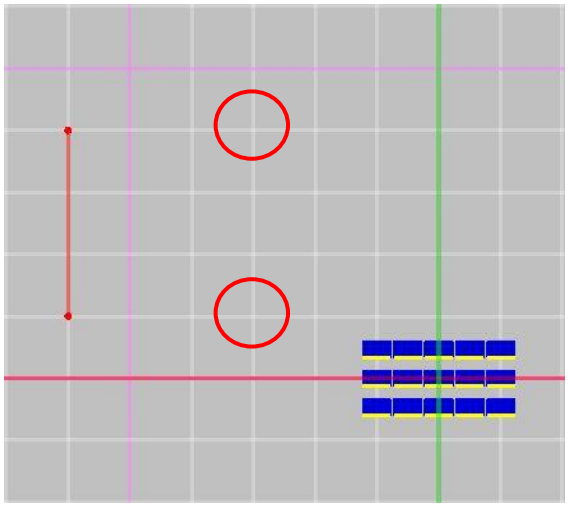
⑥ Specify the 2nd position. Click a point below the 1st point as shown below.



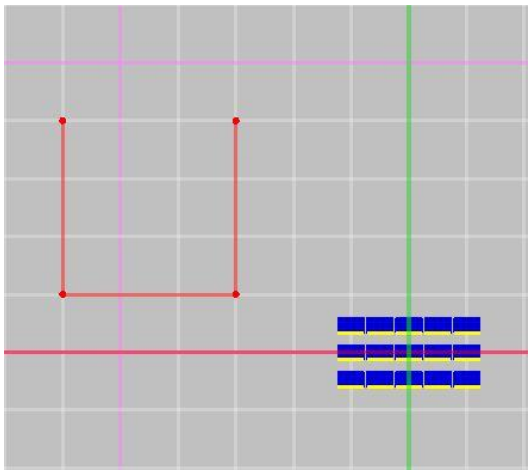
⑦ A red dot is drawn in the clicked position. The 1st dot and the 2nd dot are connected by a red line.



⑧ Specify the 3rd and 4th position. Click the positions as shown below (red circles).



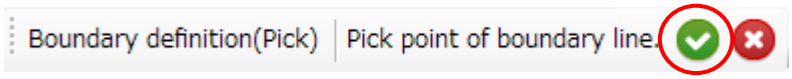
⑨ The 3rd point and 4th points are defined. A rectangle with an open top is drawn in red.



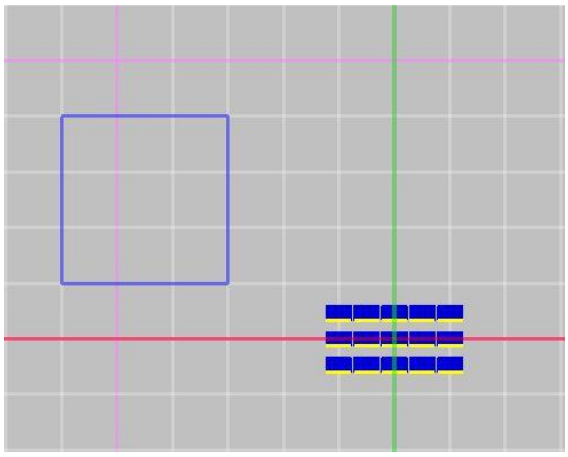
◇NOTE◇

To cancel the specified point, press the [BackSpace] key. The last point can be deleted.

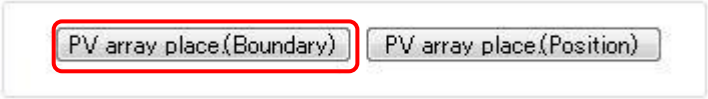
⑩ In this state, define the area. Click [OK]  (toolbar icon) or press [Enter] (keyboard).



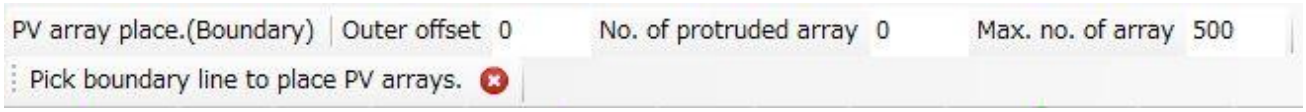
⑪ A rectangle connecting the 4th point and the 1st point is drawn in blue. The PV arrays can be placed within this area enclosed by blue lines. The [Boundary definition] mode is cancelled.



⑫ Click the [PV array place.(Boundary)]

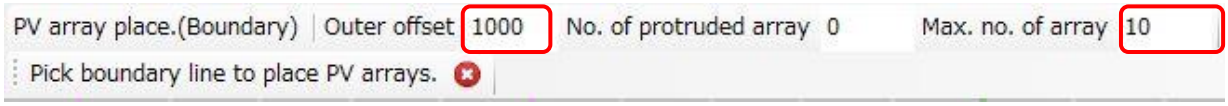


⑬ The [PV array place.(Boundary)] mode is enabled. The toolbar is displayed as the following figure.

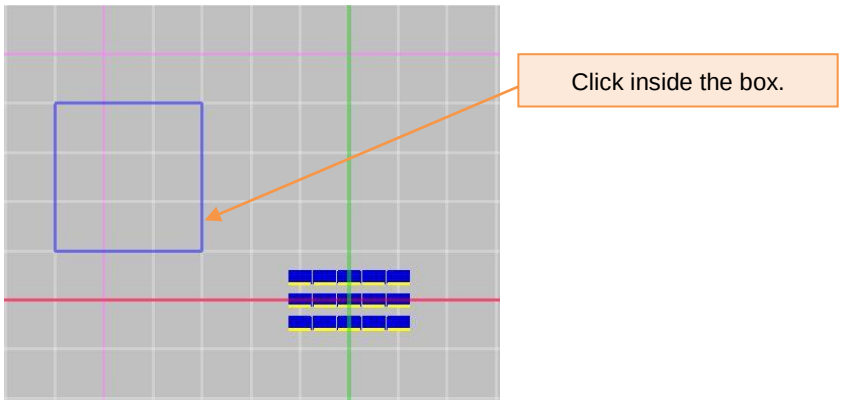


⑭ Specify 10 in [N of PV arrays] to place 10 PV arrays.

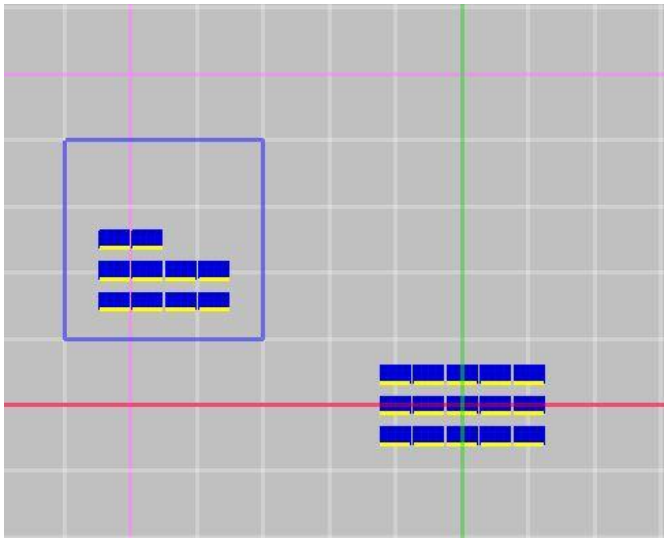
⑮ Specify "1000" in [Outer offset].



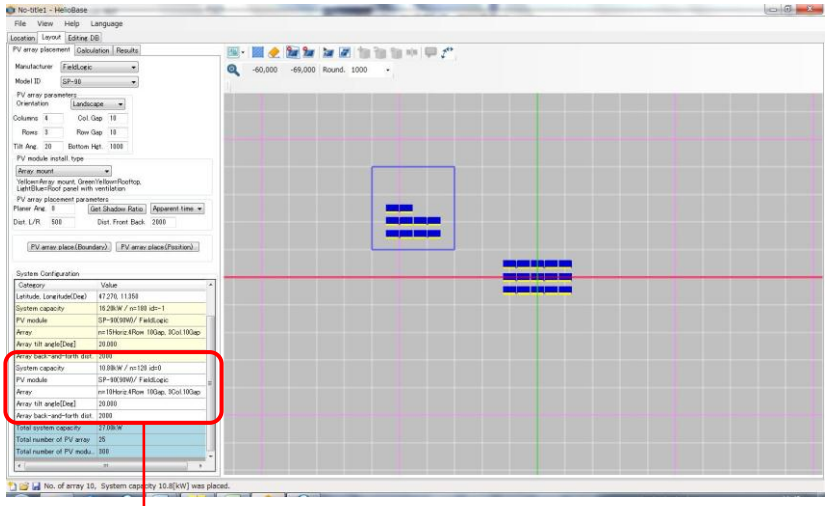
⑯ In this state, click a position in the area set in the 2D drawing.



⑰ The PV arrays are placed in the area clicked, as shown below.

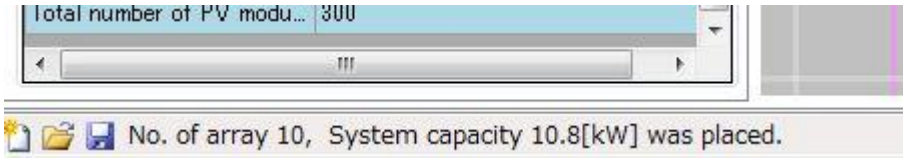


The data of the placed PV arrays is also added in the [System Configuration] box (lower left of the screen).



System capacity	10.80kW / n=120 id=0
PV module	SP-90(90W)/ FieldLogic
Array	n=10Horiz.4Row 10Gap, 3Col.10Gap
Array tilt angle[Deg]	20.000
Array back-and-forth dist.	2000

The number of PV arrays and the system capacity of the placed PV arrays are displayed at the left bottom of the display.

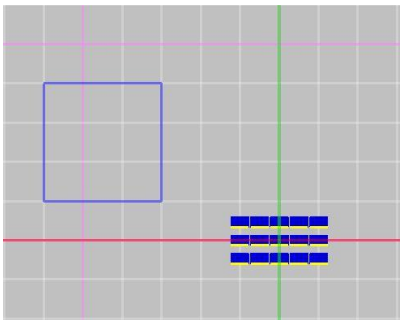


◇NOTE◇

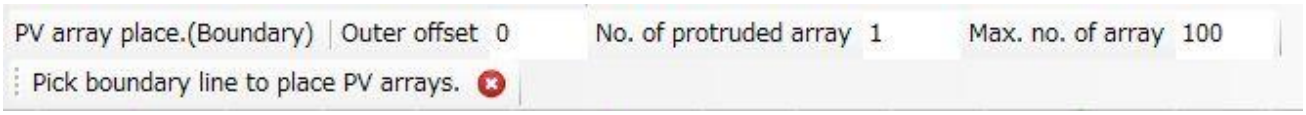
Using the number of protruded array

When using [PV array place(Boundary line)], the PV arrays which have protruded arrays from PV array placing area can be placed.

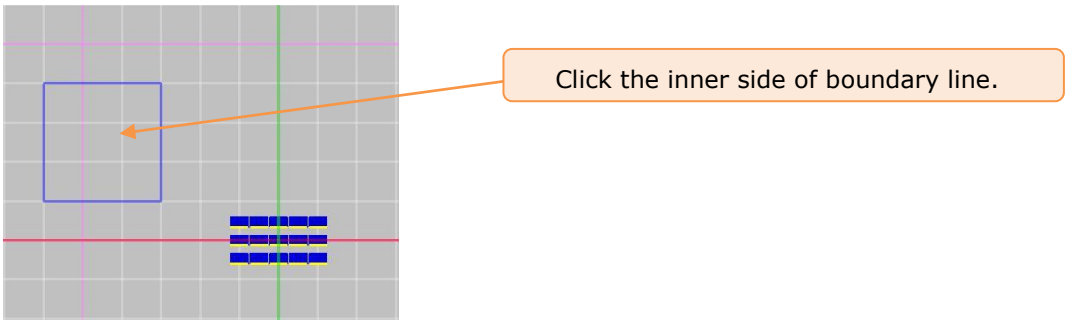
The following operations are performed on the assumption that the PV array placing area of the following figure is already set up.



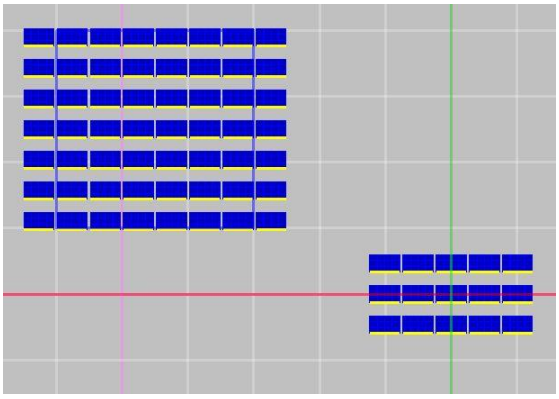
① Moving the [PV array place(Boundary line)] mode. Specifying the [Outer offset] to “0”. Specifying the [No. of protruded array] to “1”. And specifying the [Max. no. of array] to “100”.



② Click the inner side of the boundary line.



The PV arrays are placed as the following figure.



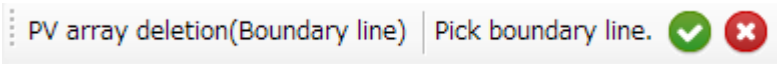
◇NOTE◇

Delete the PV arrays placed in the PV array placement area.

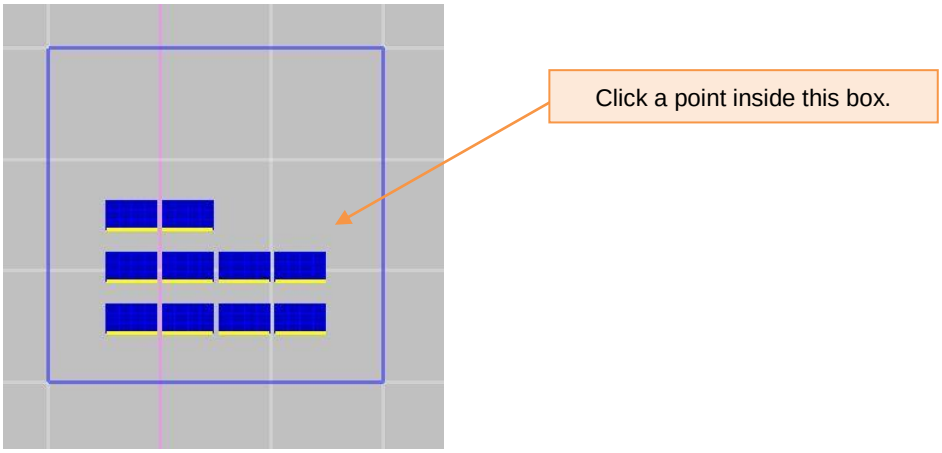
To delete the PV arrays in the PV array placement area, do the following:

① Click the [PV array deletion (Boundary line)] icon  in the toolbar icons.

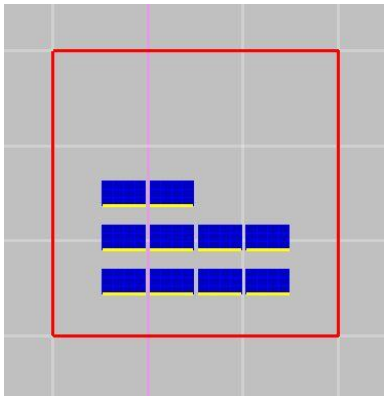
② The mode is changed to the [PV array deletion (Boundary line)] mode, and the section below the toolbar icons is changed as shown below.



③ Click a point inside the PV array placement area that contains the PV arrays to be deleted in the 2D drawing.

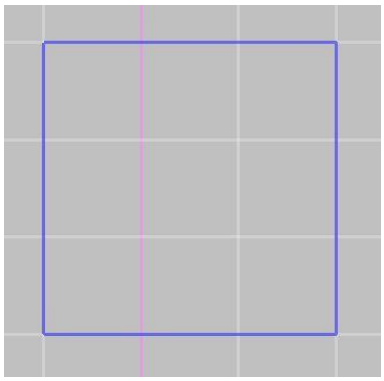


④ The border of the PV array placement area clicked is drawn in red.



⑤ Press the [Enter] key (keyboard) or click the [OK] icon  under the toolbar icons.

⑥ The PV arrays in the area drawn in red are deleted. The [PV array deletion (Boundary line)] mode is cancelled.



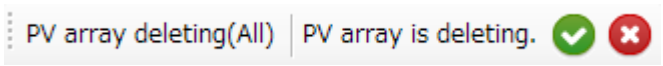
◇NOTE◇

Delete all PV arrays placed in the 2D drawing.

To delete all PV arrays placed in the 2D drawing, do the following:

① Click the [PV array deletion (Boundary line)] icon  in the toolbar icons.

② The mode is changed to the [PV array deletion (Boundary line)] mode, and the section below the toolbar icons is changed as shown below.



③ Press the [Enter] key (keyboard) or click the [OK] icon  under the toolbar icons.

④ All PV arrays placed in the 2D drawing are deleted.

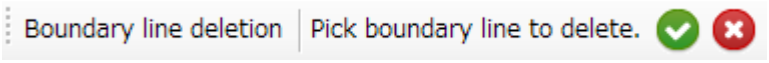
◇NOTE◇

Delete the PV array placement area that has been set.

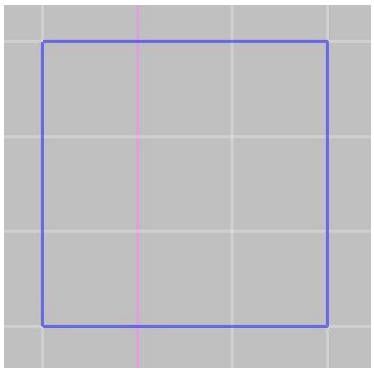
To delete the PV array placement area, do the following:

① Click [Boundary line deletion] icon  in the toolbar icons.

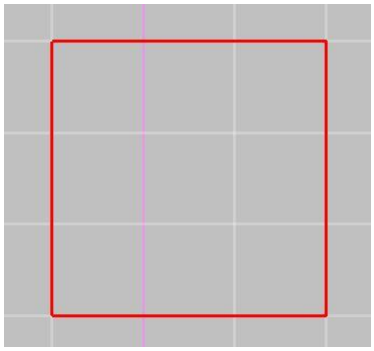
② The mode is changed to the [Boundary line deletion] mode, and the section below the toolbar icons is changed as shown below.



③ Click a point inside the PV array placement area to be deleted in the 2D drawing.



④ The boundary lines of the PV array placement area clicked are drawn in red.



* The area cannot be selected if a PV array is placed in the area.

⑤ Press the [Enter] key (keyboard) or click the [OK] icon  under the toolbar icons.

⑥ The selected PV array placement area is deleted in the 2D drawing.

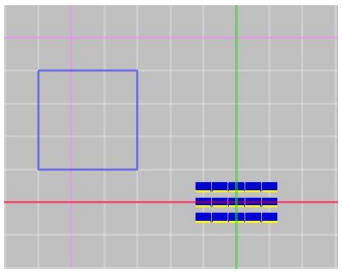
◇NOTE◇

Set a prohibited area (to place a PV array) in the PV array placement area.

A prohibited area (to place a PV array) can be set in the PV array placement area.

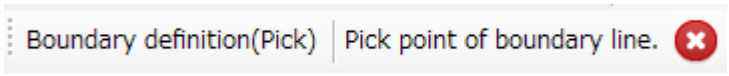
Using this function, set a large area first, and then PV array can be placed by assuming that there is an obstacle such as a building in the area.

By assuming that the placement area shown below has been set in the drawing, do the following:



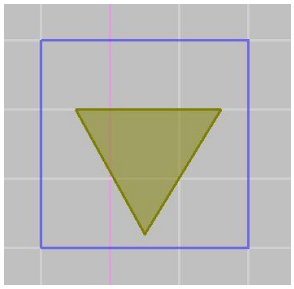
① Click [Boundary definition (Pick)]  in the toolbar in the 2D drawing.

② The mode is changed to the [Boundary definition] mode, and the following toolbar (icons) are shown.

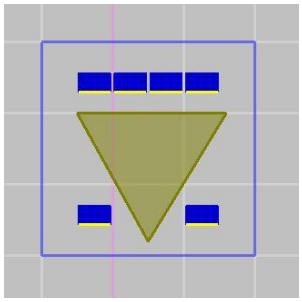


③ Set an area in the PV array placement area by the same steps as the PV array placement area is set.

④ The area set in the PV array placement area is drawn as shown below, indicating that this is a prohibited area for placing a PV array.



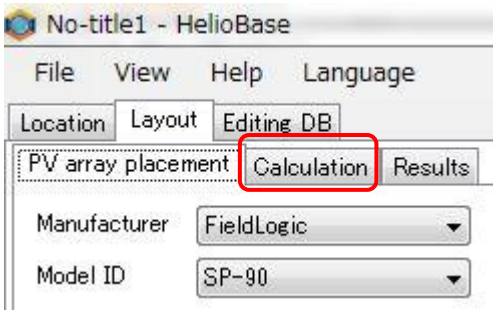
⑤ [PV array place.(Boundary line)] places the PV arrays in the PV array placement area (that includes a prohibited area for setting a PV array), as shown below.



5. Perform the Simulation

Perform the simulation to estimate the generated power according to the state of the PV arrays placed in the 2D drawing.

First, open the [Calculation] tab.

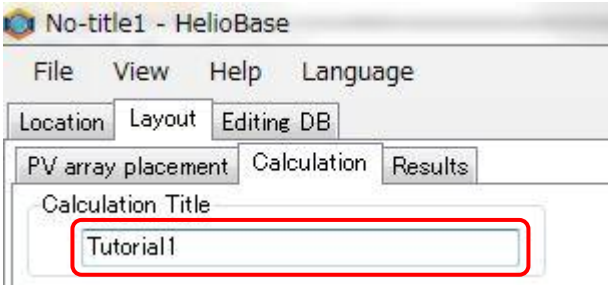


Specify the calculation parameters

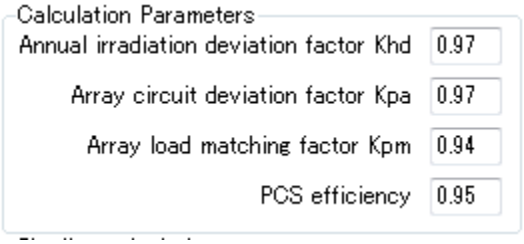
Operation: Specify the calculation title and various calculation parameters.

① Set the [Calculation Title]. The title is shown in the Excel report..

② Enter "Tutorial1" in [Calculation Title].



③ The following coefficients in the [Calculation Parameters] box can be set. Here, the simulation is done with the default values.



If any of the coefficients (parameters) need to be changed, change the value accordingly.

Annual irradiation deviation factor (Khd)

Array circuit deviation factor (Kpa)

Array load matching factor (Kpm)

PCS (power conditioner) efficiency...

Shows the output power efficiency of the power conditioner used in the generated power simulation.

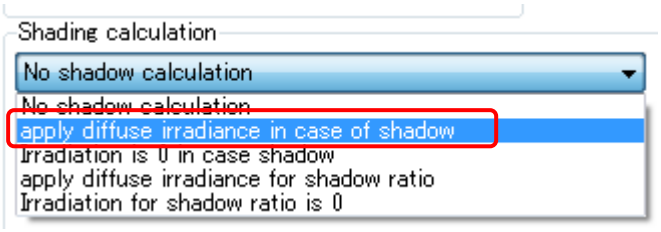
Specify the shadow calculation method

Operation: Specify the shadow calculation method.

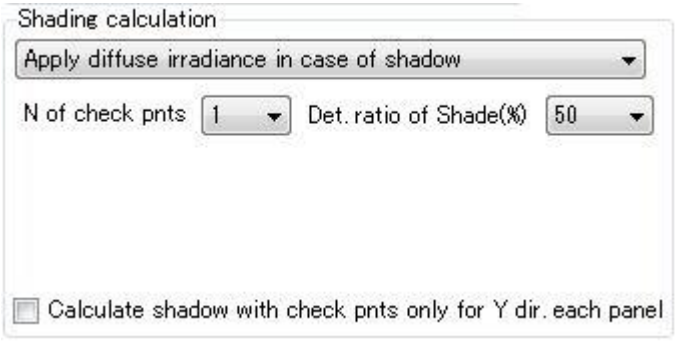
Select how the effect of the shadow created by the placed PV arrays should be reflected in the simulation and specify the parameters.

There are multiple shadow calculation methods. Here, [apply diffuse irradiance in case of shadow] (calculation method), [N of check pnts] (4 points) and [Det. ratio of Shade (%)] (50%) are used for simulation.

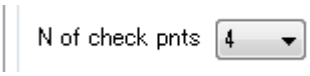
① Select [apply diffuse irradiance in case of shadow] in the top list box in the [Shading calculation] box.



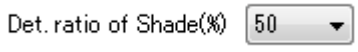
② The [Shading calculation] box is changed to the following display.



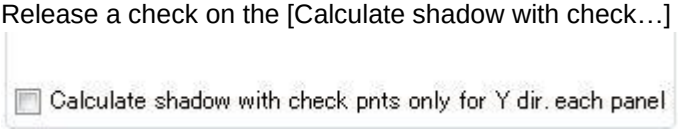
③ Select "4" in the [N of check pnts] list box.



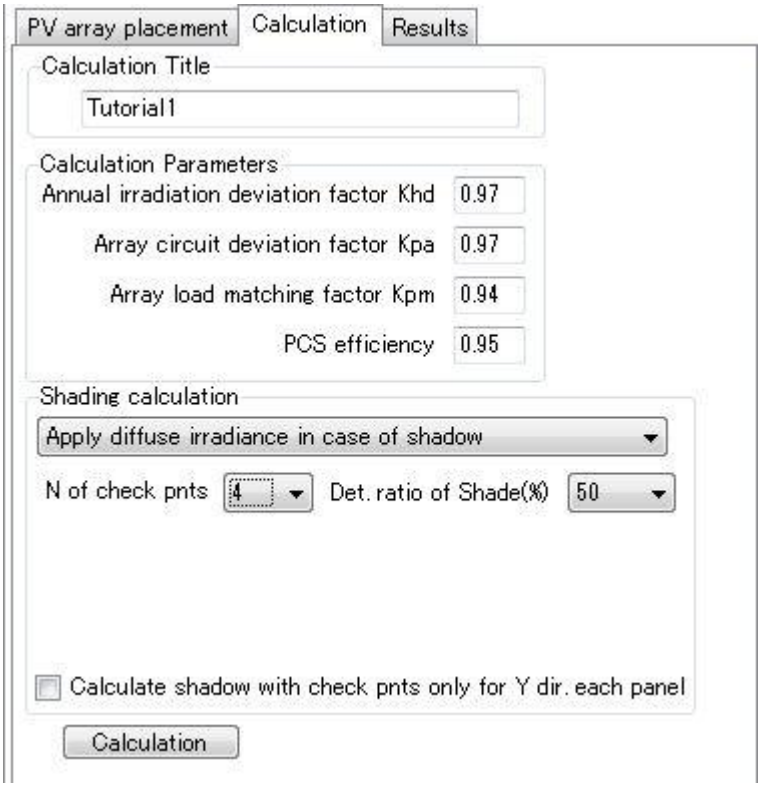
④ Select "50" in the [Det. ratio of shade(%)] list box.



⑤ Release a check on the [Calculate shadow with check…] check box.



⑥ The [Shading calculation] box after the parameter specification shows the following:



◇NOTE◇

Shading calculation types and parameters

The following two options optimize the simulation. By limiting the conditions, the calculation is done faster but there will be more calculation errors.

[Calculate shadow with check pnts only for Y dir. each panel] check box

To optimize the simulation, whether the point is "shadow" or not only in the Y direction.

[N of check pnts]

No. of internal check points (divisions) to determine the shadow. The more check points there are the more calculation precision is increased for the effect of the shadow for the irradiation but the calculation speed is slower.

[Det. ratio of Shade (%)]

Threshold to determine whether the PV module is in the shade.

There are several shade calculation methods as described below.

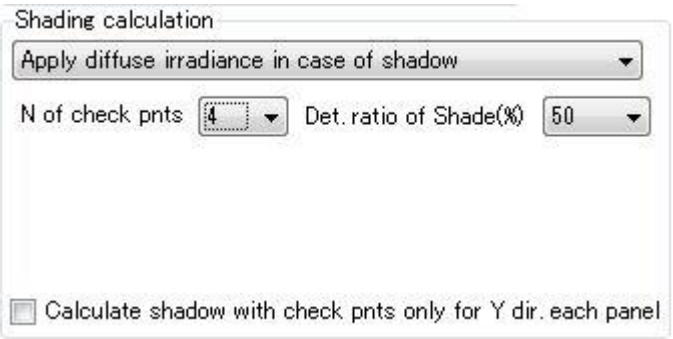
[No shadow calculation]

The shadow calculation is not done.

[apply diffuse irradiance in case of shadow]

Simulation is done by using only diffused irradiation as the irradiation for the PV arrays which have been determined to be "shadowed".

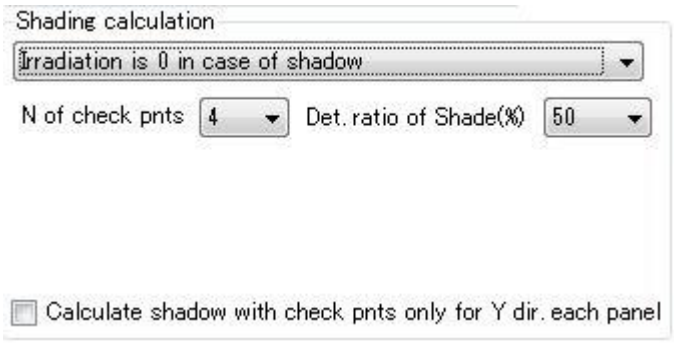
Specify two parameters – [N of check pnts] and [Det. ratio of Shade (%)] (threshold to determine if the PV arrays are in the shade).



[Irradiation is 0 in case shadow]

Simulation is done by assuming that the irradiation is 0 for the PV arrays that have been determined as "shadowed".

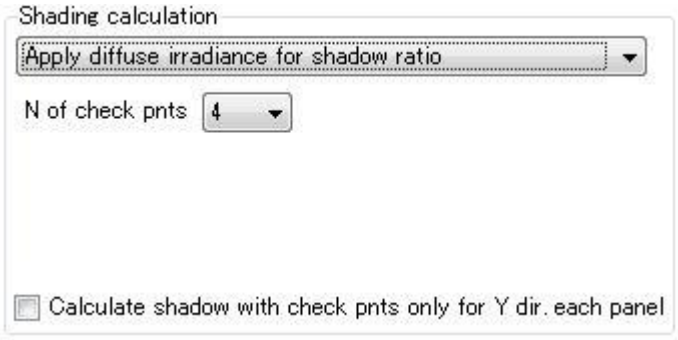
Specify two parameters – [N of check pnts] and [Det. ratio of Shade (%)] (threshold to determine if the PV arrays are in the shade).



[apply diffuse irradiance for shadow ratio]

Simulation is done by using only diffused irradiation as the irradiation for the shadow ratio for the PV arrays (determined according to the number of shade check points).

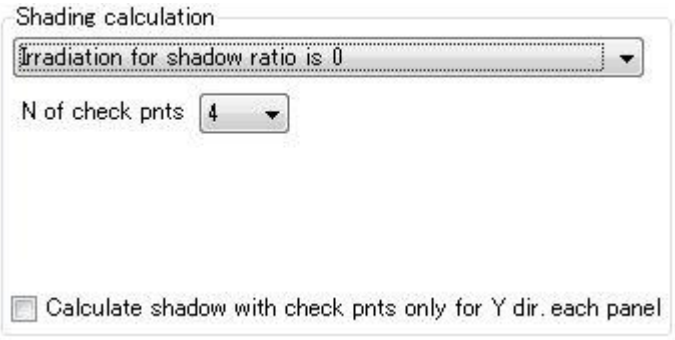
Specify [N of check pnts].



[Irradiation for shadow ratio is 0]

Simulation is done by assuming that the irradiation of the shade ratio for the PV arrays (determined by the number of shade points) is 0.

Specify [N of check pnts].

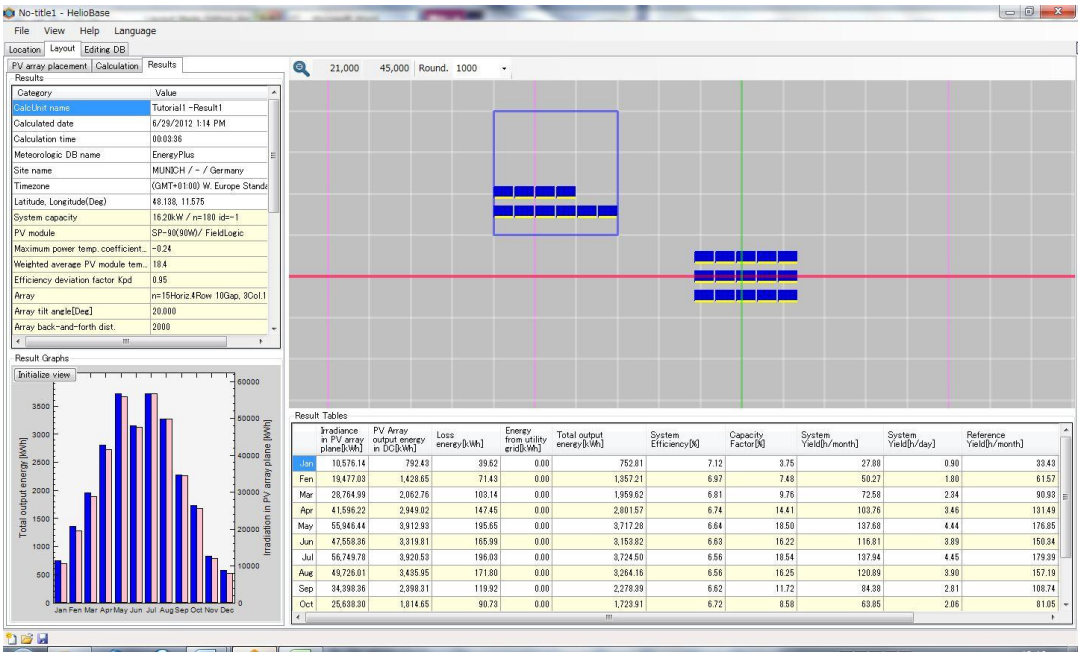


Calculation

Operation: Perform the simulation.

① Click the [Calculation] button.

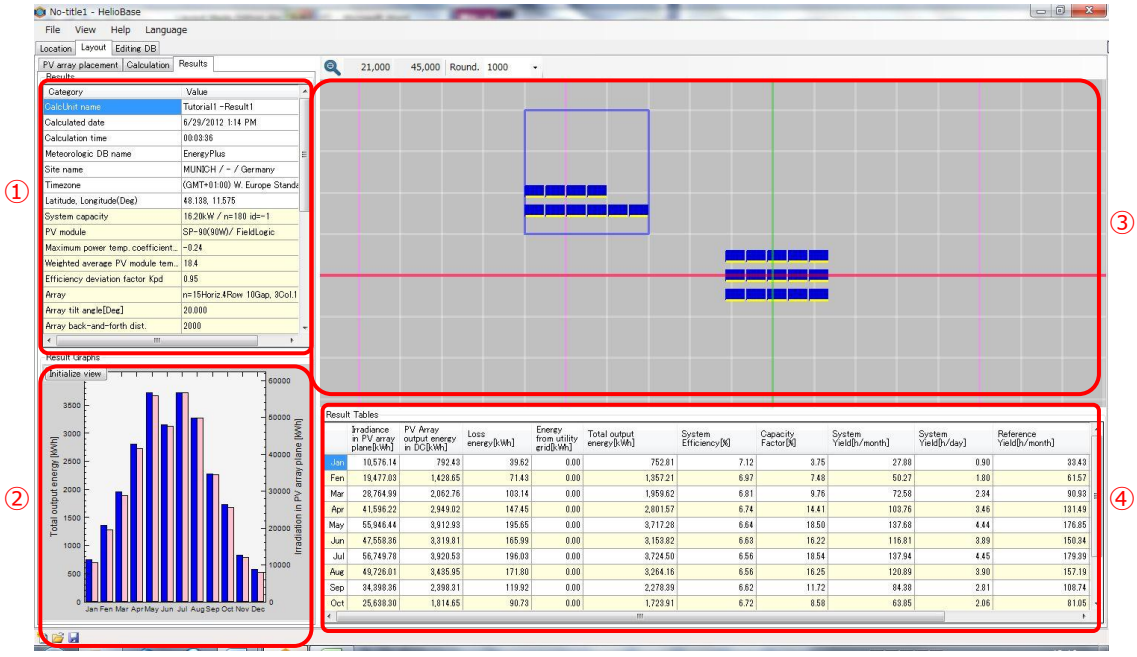
② The simulation (calculation) starts. After a short time, the [Results] tab automatically opens where the calculation results are displayed.



6. Verify the Simulation Results

Verify the simulation results on the screen.

Operation: Verify the simulation results on the screen



① Calculation elements…

Shows the meteorological data, PV modules, calculation conditions, etc. used in the simulation.

② Result Graphs…

Shows the generated power (monthly) and PV plane irradiation in bar graphs.

③ 2D Drawing…

Shows the 2D drawing used for the simulation.

④ Result Tables…

Shows the simulation results (values) tallied monthly.

[Irradiance in PV array plane]…

Irradiance to the PV arrays placed.

[PV Array output energy in DC] [kWh]…

Generated power output by the PV arrays.

[Loss energy[[kWh]…

Power loss until the final power output through the power conditioner.

[Energy from utility grid] [kWh]…

Received power from the utility grid.

[Total output energy] [kWh]…

The value that the power loss and load power are subtracted from the PV output power.

[System Efficiency] [%]…

The value (%) that the total output power is divided by the PV plane irradiation.

[Capacity factor] [%]…

The value (%) where the total output power (monthly) is divided by the total of the nominal maximum output of the PV array and the total time (month).

[System Yield] [h/month]…

The value where the total output power (monthly) is divided by the nominal maximum output of the PV array.

This value shows how many hours are required for the system to generate power equivalent to one month if the PV array runs continuously in the nominal maximum output state.

[System Yield] [h/day]…

Equivalent system operation time for 1 day. The value is calculated as the equivalent system monthly operation time divided by the number of days in the month.

This value shows how many hours are required for the system to generate power equivalent one day if the PV array runs continuously in the nominal maximum output state.

[Reference Yield] [h/month]…

This value shows the time required to supply the PV plane irradiation (month) with the irradiation intensity of the standard state (1.0kW/m2).

This value is calculated as PV plane irradiation divided by the PV array area.

[Performance Ratio] [%]…

The value (%) is calculated as the equivalent system operation time divided by the equivalent solar irradiation time.

This value is used as an index to describe the PV system performance.

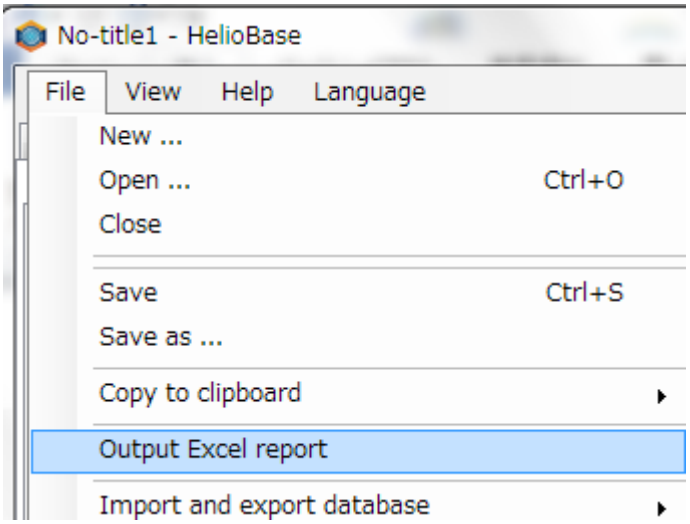
[Irradiance in PV array plane] (kWh/m^2]…

The value shows that the PV plane irradiation is divided by the PV array area.

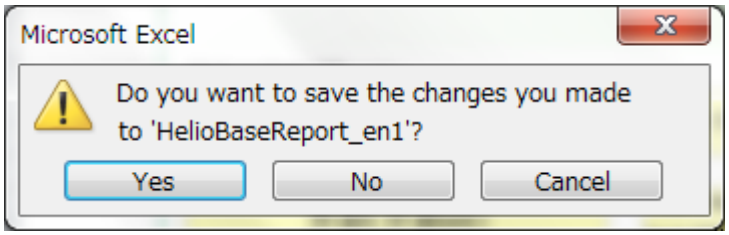
Output – Excel report

Operation: The simulation results can be output as a report in the Excel file.

① When the [Results] tab is open, select [Menu] – [File] – [Output Excel report].



② Excel starts. The dialog box asks to save or not save the changes. To verify the results then, select [Cancel]. To save the changes, select [Yes]. To abort the report, select [No].

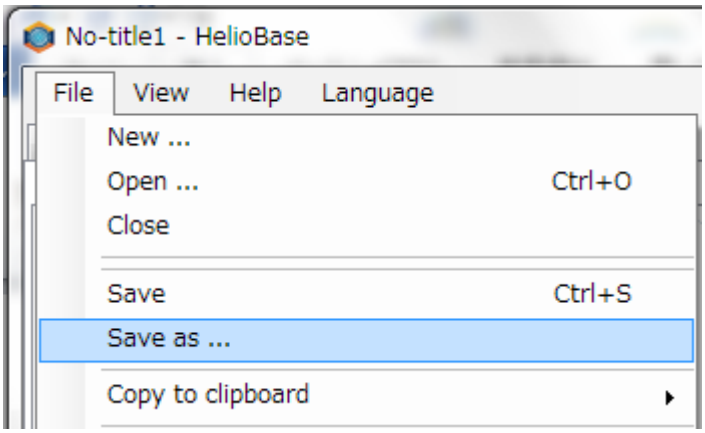


7. Saving the Simulation Contents and Terminating the Application

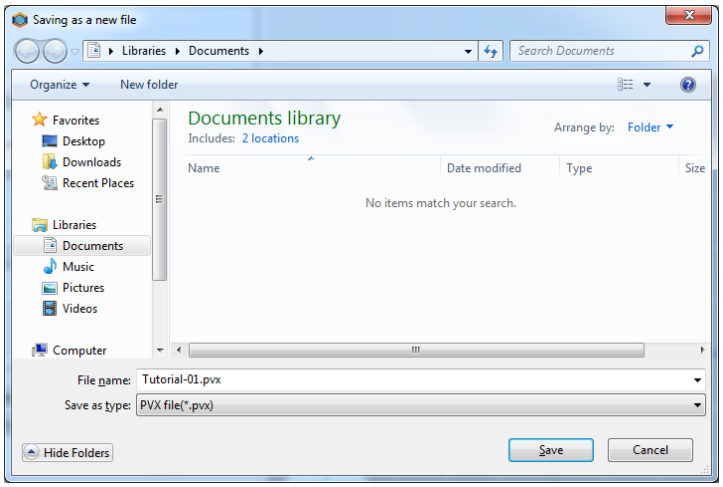
Save the simulation contents and terminate the application.

Operation: Save the simulation contents (PV array placement, etc.)

① In the menu, select [File] – [Save as...].



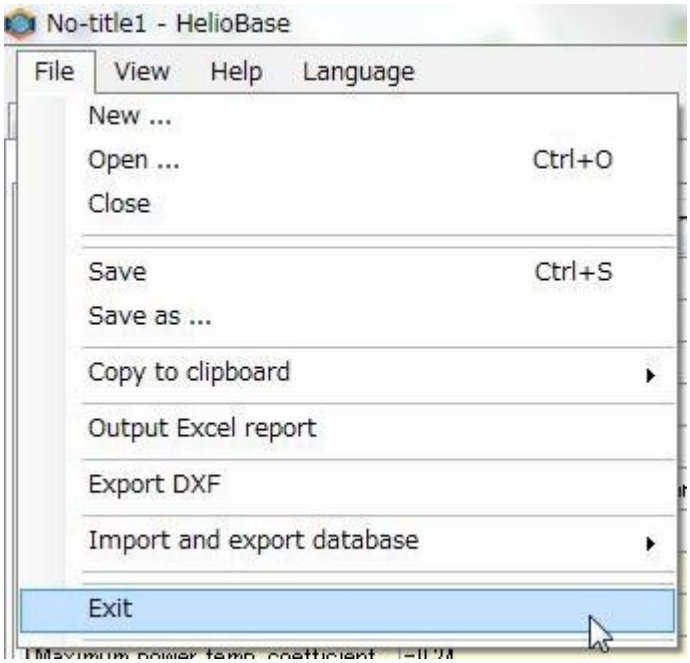
② The [Save as...] dialog box appears. Enter a name in the [File name] box and click the [Save] button.



Terminating the application

Operation: Terminate the application.

Method 1: From the menu, select [File] – [Exit].



Method 2: Click the [Close Window] button in the upper right corner of the screen.

If the work being done when the application is terminated is not saved, the [Confirmation of cancelation of changes] dialog box appears.

Click [No] to save the work. The application will not be terminated.

Click [Yes] to terminate the application without saving the work.